

Research Note 84-129

MODEL OF TEAM ORGANIZATION AND BEHAVIOR AND TEAM DESCRIPTION METHOD

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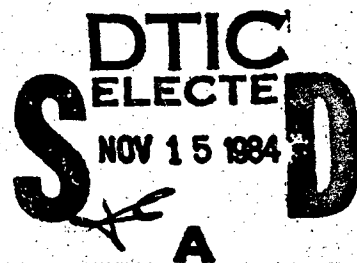
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report describes a model of team organization and performance, and a method for describing the structures and behavior of teams. Both the model and description method were developed and validated through the field observation of Army teams performing selected team missions. The model is a set of concepts which are used to describe the formal and actual (mission) structure of teams and the behavior of teams and team members. The description method essentially provides a structured means of identifying, gathering, and verifying the data required to describe teams and team missions, using the concepts of the model.		

MODEL OF TEAM ORGANIZATION AND BEHAVIOR AND TEAM DESCRIPTION METHOD

EXECUTIVE SUMMARY

Requirement

The objectives of this first year of a three-year research effort were to develop two research products: (1) a model of the organization and performance of any military team performing any team mission; and (2) a structured, procedural method for describing the structure, organization, and performance of teams, based on the model. This report describes both the model and description method, including discussions of the way in which these two products were developed and validated.

Procedure

The investigators initially recognized that no existing model of team or small group behavior was sufficiently general and comprehensive to be used as a foundation for the model to be developed. Under this basic condition, a "primitive" model of the behavioral elements of team performance was created at the outset of the effort. This primitive model evolved into the present model in two ways. First, the existing literature on team and small group behavior was reviewed to identify useful concepts which could contribute to a general model of team organization and behavior. Potentially useful concepts were synthesized and incorporated into the primitive model. Most major features of the model were developed through the observation of a variety of Army teams performing many different team missions. Four "waves" of observation were conducted during model development at different FOKSCOM posts. At each post, several observers watched teams performing missions and discussed the missions with members of the teams that were observed. Each of the teams, and missions, performed was described in terms of the concepts of the model as it existed at the time of observation. When new concepts or features were needed to adequately describe teams or missions, such concepts were developed and refined by the project team between observation sessions. Eventually, the model and its components became complete enough to accurately describe all the organizational and behavioral characteristics of all teams and missions observed during model development. The completeness and generality of the model were verified by observing both team types and missions that had been previously observed and those that had not. The concepts and constructs of the model were found to be adequate for describing the organization and the mission performance of the teams observed during verification.

The team description method was developed in parallel with the model, as the model evolved. When new concepts were added to the model, ways to describe the team organization or performance characteristics associated with the new model concept were explored.

The new or revised description techniques were evaluated during field observation, and the ability of the techniques to yield accurate information in the desired form was assessed after trial use. Description techniques which were found to be overly cumbersome or difficult to use or which did not result in the quality of data desired were revised, or discarded and replaced by alternative procedures. The utility and comprehensiveness of the description method was validated by applying the description techniques to team types not observed during creation of the model and description method. Several shortfalls in the original description method were discovered during validation, and modifications to the description method were made to overcome the problems generated by those shortfalls. These changes are reflected in the description method as it is presented in the body of this report.

Findings

The model consists of two parts. The first part consists of a set of concepts and terms for describing the structure and organization of teams both in the abstract--i.e., out of context of particular missions (nominal team structure), and in the context of particular missions that are performed by teams (actual team structure). For each type of team structure, a number of terms and descriptive dimensions are defined. The second part of the model deals with concepts, terms, and approaches for describing the behavior of teams as the teams perform missions. Only two basic components are needed to describe the behavior of a team under this model: description of the individual tasks performed by team members and the dependencies among team members (dependencies are events in a mission where one team member receives input from one or more other team members which permits the receiving member to initiate, continue, or complete his individual tasks).

The description method based on the model contains four steps. Each step has associated with it a set of data requirements and procedures for data gathering and presentation. The first step is concerned with identifying the teams and team types to be described, and selecting teams for description. Step two deals with preparing detailed descriptions of the structural and organizational characteristics of the teams selected in step one. The third step concerns selecting missions to be described for the team types selected in step one. The fourth and final step deals with describing the behavior, structure, and performance of teams as they perform the missions selected in step three. Detailed procedures for recording, analyzing, and describing the performance of teams are provided in discussion of each step. Standardized documentation forms to record data, observations, and decisions aggregated during preparation of team descriptions are included, and procedures for data recording are provided.



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Utilization of Findings

The model has already been used in the development of the method for describing the structure, organization, and performance of teams in this first year's effort. The model and the description method will be extensively refined in the following years of the effort, and used to provide the foundation for several developments: creating methods for evaluating the performance of teams; developing a method for identifying team training requirements for various types of teams; and evolving guidelines for selecting techniques for team training.

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The authors of this report are deeply aware that the progress and developments that have been made to date in our understanding of and ability to conceptualize the structure, organization, and behavior of teams could not have taken place without the contribution and cooperation of many individuals. We wish to acknowledge the efforts, patience, assistance, and frequently forbearance, of members of the following units which were observed or with which we visited in the first year's effort:

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SECTION 1

MODEL OF TEAM ORGANIZATION AND BEHAVIOR

INTRODUCTION

This report describes a model of team structure and behavior based on the observation and study of real-world (Army) teams and team missions. Unlike many previous team performance/team behavior models, the model described here was based on the assumption that it would ultimately be used to support assessment of team performance in the real world and the development of team training programs. This is not intended as a criticism of previous research in team behavior, but as a comment on the utility of the findings of team research to date. Most studies of teams and team performance to date have been basic and exploratory: attempts to describe and explain the differences in performance of teams from that of individuals. A very wide variety of group entities and tasks has been studied under the general rubric of "team research," and many valuable observations and speculations have resulted from this work. Many attempts have been made to model both the performance of teams and the effects of various characteristics of team organization and structure on team performance phenomena.

The diversity and variety of group entities and tasks that have been studied previously has led to the development of nearly as many exploratory and descriptive concepts about team performance as there have been researchers in the field. Unfortunately, the very variety of situations studied and investigative orientations has resulted in a situation where the findings and concepts of team research cannot be integrated in a meaningful, theoretical way. There is no predictive theory of team performance in existence, despite the large body of data on team performance and the many descriptive models that have been developed. The wide variety of definitions of what kinds of entities are to be called teams (and the frequent failures to define the boundaries of teams as opposed to other entities), the diversity of team tasks or missions studied, and the frequently contradictory results of studies make a general theoretical statement impossible.

One difficulty in arriving at any theoretical picture of teams in general is the lack of a set of concepts sufficiently general to describe all possible teams and team missions/tasks in a consistent and comparable way. Such a set of concepts could be thought of as a "language of discourse" for thinking about and studying teams and team behavior. Such a set of concepts, if widely accepted, could be used to describe the characteristics of the structure, organization, and behavior of any team in ways that would make the comparison of teams and team behaviors possible. With a large enough set of team-characteristic descriptions based on the same set of concepts and description rules, the relationships between team structure, missions, and performance can be identified. Relationships between these characteristics of teams can eventually lead to general or

specific predictions or hypotheses about the ways in which various characteristics of teams, team tasks, and the environment in which teams perform influence the behavior and performance of teams. A sufficiently general set of validated hypotheses will lead to the much-desired "theory of team performance."

The model described here represents the first step toward a general theoretical statement about team behavior and performance. This model is a consistent and understandable set of concepts for describing the structure, organization, and behavior of teams, based on the observation and study of a variety of real-world teams performing real-world missions. Since time and resources for model development were limited, only a representative variety of Army teams could be observed to develop model concepts. Thus, this model is viewed as probably incomplete from one or more viewpoints. The authors believe, however, that this model represents a good first approximation to a consistent method of thinking about and studying team behavior and performance, which can be easily expanded and refined to represent all the important or necessary characteristics of teams and the performance of teams.

The remainder of this section is divided into three chapters. First, a brief discussion of the way in which the model was developed is offered. The limitations of the model are also discussed in a general way. Next, the concepts of the model are presented in detail. Finally, a brief discussion of planned future developments to the model and attempts at application of the model is presented.

MODEL DEVELOPMENT AND LIMITATIONS

Development of the team structure and behavior model was performed in two stages. The first stage began with a detailed review of the available literature on team and small group behavior. The emphasis of this review was to discover key concepts relating to the structure and behavior of teams which could be synthesized into a set of understandable and general methods of describing teams and their behavior. Stress was placed on identifying integrating concepts of team structure and performance, definitions of teams (boundary conditions that discriminate teams from other group entities), and models of team behavior.

When data or concepts relevant to any of these key areas were discovered, the data were integrated into a primitive model of team behavior. This primitive model was only a conceptual framework into which useful concepts could be integrated, rather than an attempt to pre-specify a set of concepts. The primitive model stressed two key elements of team behavior:

- . the performance of individuals in team context as the individual performance contributes to the performance of the team as a whole; and
- . the dependencies among team members required to accomplish team tasks or missions.

The primitive model did not contain specific concepts related to these two elements, nor any concepts related to team structure or organization. It was felt that maximum flexibility would result if existing concepts were reviewed and synthesized, rather than providing limiting categories into which research findings and concepts would be sorted.

Based on the literature review, the primitive model was expanded into a set of team structural and behavioral concepts which were felt to incorporate the useful findings and speculations of previous work without being limited by the constraints inherent in the body of data evolved to date. A number of extremely useful and critical features were added to the primitive model as a result of the review of existing literature. For example, the original primitive model had no way to characterize the structure and organization of teams in a consistent way. A number of team structure and organization concepts found in the literature were considered together and the best features of each of these were synthesized to form a set of structural concepts and terms which were felt to have face validity for description of any type of team. These terms and concepts were added to the primitive model.

Table 1

Team Types, Sites, and Missions Observed
During Model Development and Validation

<u>Team Type</u>	<u>Site</u>	<u>Missions Observed</u>
4.2-in (107 mm) Mortar Squad	Ft. Benning, GA	Registration and adjust fire, repeat fire mission, split mission (two sections)
Improved Tow Vehicle (ITV) crew	Ft. Benning, GA	Dismount TOW, mount TOW, simulated fire missions, reload, immediate action
Infantry Squad	Ft. Riley, KS	Prepare tactical fighting positions, conduct reconnaissance patrol, daylight defense, provide security for combat engineers
81 mm Mortar Squad	Ft. Riley, KS	Registration and adjust fire, repeat fire missions, traversing fire, reduced strength fire missions (1 and 2-man)
81-mm Fire Direction Center (FDC)	Ft. Riley, KS	Call for fire (initial), adjust fire missions, section split missions, reduced strength (2 men)
TOW Crew	Ft. Riley, KS	Dismount and emplace TOW, erect camouflage and improve positions, simulated fire missions, disassemble TOW and remount vehicle
Combat Engineer Squad	Ft. Riley, KS	Install triple standard concertina obstacle, install tactical minefield, construct antitank trench

Table 1 (concluded)

Team Types, Sites, and Missions Observed
During Model Development and Validation

<u>Team Type</u>	<u>Site</u>	<u>Missions Observed</u>
Infantry Squad	Ft. Benning, GA	Squad tactical training missions: movement to contact, deliberate daylight attack, squad movement techniques drill, night attack, obstacle crossing, body search, military operations in urban terrain (MOUT)
ITV Crew	Ft. Benning, GA	Operational checkout, reload and immediate action, crew drill (mount/dismount TOW), simulated firing and tracking
Assault Ribbon Bridge (ARB) Platoon	Ft. Benning, GA	Staging, launch, and recovery of bridge sections and bridging boats, construction of 5-bay raft, rafting, bridge construction
4.2-in Mortar Squad	Ft. Benning, GA	Night illumination firing
4.2-in FDC	Ft. Benning, GA	Night illumination firing
Infantry Squad	Ft. Bragg, NC	Movement to contact, deliberate attack, hasty attack, construction and camouflage of defensive positions, defend positions against attack
----- VALIDATION BELOW -----		
Infantry Squad, Platoon	Ft. Campbell, KY	Movement to contact, hasty attack, hasty defense, raid, deliberate defense
105-mm Artillery FDC	Ft. Campbell, KY	Initial call for fire, adjust fire, split missions, repeat missions

subjected each concept and construct to a series of questions, answered by the project team as a whole. The questions used were:

- . Is the concept clearly defined by example in the observations, and can the concept or construct be stated and easily defined in a comprehensible way?
- . Does the concept appear to be consistent and generalizable across team types and missions? Is there reason to believe that the concept should be broken down into sub-concepts that more clearly and explicitly reflect what has been observed? What breakdowns appear reasonable?
- . Does the concept or construct add materially to our ability to describe the structure or behavior of teams? Does the concept "fill holes" in characterizing team structure and behavior, or does it merely duplicate other concepts?
- . Is the concept or construct meaningful? Does it represent a genuine characteristic or attribute of teams and their performance, or is it merely an observational artifact?

General, but binding, criteria for the model were selected and adopted at the outset of the effort, and are reflected in the questions used to evaluate candidate concepts for inclusion in the model. The criteria used in model development were:

- . The model must be as complete as possible given observational and conceptual limitations. That is, the model must be able (ideally) to account for or describe any and all phenomena associated with team performance in terms of model concepts. Inferences as to the processes underlying team performance are viewed as inferences, over and above the descriptive concepts of the model.
- . The model must be parsimonious. Only the concepts and constructs that are truly vital to describing team behavior and performance may be included. These concepts must be as precisely defined as is possible, but definition by example is acceptable in addition to statement of a concept, for purposes of clarification.
- . The model must be general. Model concepts must be based on repeated, consistent observation of the phenomenon the concept deals with in multiple teams and/or missions. Concepts based on single observations (i.e., one team type performing one mission) are not considered sufficiently general for inclusion in the model, unless the concept is clearly generalizable by projection (e.g., it is clear that the concept will be useful, in general, to describe team behavior and/or performance).

The concepts and constructs of the model presented in this report conform to the criteria listed above. In addition to these criteria, however, other characteristics of the model are discussed below.

Limitations of the Model

The current model of team behavior and performance is in some ways limited. Some of these limitations are deliberate; that is, the limitations are intrinsic features determined by the type of model to be developed. Other limitations are due to limits in the data available for model building. Several known limitations to the model exist.

First, the observations on which the model is based have been limited to relatively few Army team types: Infantry rifle squads, mortar squads, Combat Engineer squads and platoons, TOW crews, mortar and artillery fire direction centers, and assault ribbon bridge platoons. Although these team types (and missions observed for each team type) are felt to be reasonably representative of Army teams at large, there is the possibility that some important team phenomena may not be present in the teams and missions observed. Although the model is internally consistent and able to account for team phenomena of the team types and missions that have been observed, the model may not be complete or entirely externally consistent. There may be team phenomena unique to team types and missions other than those observed to build the model for which the model cannot account in its present form. It is believed that the conceptual structure of the model is flexible enough to allow additional team structure, behavior, and performance concepts to be added to the model readily. The model is open-ended, as an evolutionary model ideally should be, allowing for ease of expansion or modifications of the concepts that presently make up the model, in order to accommodate additional team phenomena that may be necessary to increase the generality of the model.

A similar limitation comes from the fact that only Army teams have been observed in creation of the model. This may limit the generalizability of the model. It is felt that the model concepts are sufficiently general in nature and scope that this will not be the case, but no attempt has been made to apply or test the model outside the teams observed in developing the model. Should such applications reveal a need for expansion or modification of the model, this can be easily accomplished.

The model offered in this report is not considered a "final" model. Rather, the model is in the midst of its evolution toward generality and comprehensiveness. Subsequent efforts will be directed toward redefining, sharpening, and augmenting the model and its component concepts in the directions of simplicity, parsimony, and generality. The model itself will never be considered "final," since

the model will always be open to expansion and modification of concepts to improve the understandability and usability of the model.

Perhaps the most important limitation of the model at this point is that it is not predictive. It is not presently possible to apply the characteristics of a given team and team task (mission) under the model and derive predictions of the behavior or performance of the team. The model at this time is viewed as purely descriptive; as a "language of discourse" for the description and study of teams, team performance, and team behavior. Current knowledge suggests that the model can ultimately be used in a limited predictive fashion to develop hypotheses about salient characteristics of the behavior and performance of teams. No attempts to apply the model in a predictive sense have yet been made, however, due to a limitation of available data on team performance.

A final limitation of the present model is that, as yet, no specific attempts have been made to use the descriptive concepts of the model to account for observed team behaviors and behavioral variables. In fact, it is not possible at this time to make such attempts, due to a lack of data. The data that would be needed to relate the model concepts to specific aspects of team performance, in an explanatory or predictive sense, do not exist at this time, and probably will not be acquired in the future. These data would consist of descriptions of the performance of a very wide variety of team types, each performing the full spectrum of team missions (tasks) appropriate to the team type. The data acquired on team performance and behavior would be contrasted to other team characteristics, such as team structure and composition, individual team member proficiency, and other factors, in attempts to discover the predictive or explanatory value of model elements to team behavior. As mentioned previously, it is unlikely that such a database of team behavior descriptions will be developed, since the resources and time required would be prohibitive for the probable low operational benefits to be derived from such an exercise. As a theory-building procedure, however, this approach would be totally appropriate.

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MODEL OF TEAM STRUCTURE, ORGANIZATION, AND BEHAVIOR

Basic Definitions - Team and Team Mission

A major difficulty in integrating the existing literature on teams and team performance is the wide variety of definitions that have been used to differentiate teams from other groups. Few of the definitions agree beyond the stipulation that a team is composed of two or more people working in some way toward a common objective. For the purposes of this model, none of the definitions offered by other researchers in the team/team performance field was felt to be complete or adequate. After considerable study, the following set of characteristics was chosen to discriminate teams from other group entities:

- A team is composed of two or more persons. There is no arbitrary upper limit on the size of a team. There are, however, some practical difficulties in describing the behavior of large teams.
- All members of a team are involved in a common mission, and in the context of that mission, work to fulfill a common objective. The term mission was chosen (rather than task) for the model, for two reasons. First, the activities of military teams are conventionally termed missions, and use of this term avoids confusion. Second, the term task is employed in the model to characterize the behavior of an individual team member in the context of the team mission. A great deal of semantic confusion occurs when attempting to discriminate individual tasks and team tasks. Therefore, it was decided to use different terms for the two concepts. An individual performs tasks that contribute to accomplishment of a team mission.
- The responsibility for performing the various tasks that are necessary to accomplish a team mission is divided among the team members. Each team member performs one or more tasks in the team mission context.
- There exist dependencies among the various roles involved in performing any team mission. Dependencies occur at events or times in a mission where, in order to continue with or initiate mission-related tasks, one or more team member(s) require input of some sort from one or more other team member(s). Dependencies can be conceptualized as points of interaction between the members of a team in mission context. In any team mission, there are a minimum of two dependencies. The absolute minimum case would consist of one member of a two-person team signaling the initiation of the mission to the other, the two

performing independent tasks required to complete the mission, and the signaling of completion of his assigned tasks by one member. In reality, there are typically many dependencies involved in the performance of any mission by any team.

Any entity that conforms to the conditions listed above is considered a team for purposes of this model. These conditions are only boundary, or exclusionary, criteria for the existence of a team, however, and do not provide any more information about the characteristics of an entity than whether or not the entity is a team.

A team may be possessed of a formal organizational structure which is characteristic of the team type represented by the team. Teams which persist over time will invariably have some organizational structure, if only to identify the various team members. The teams observed in creation of the model all possess persistent, relatively consistent formal organizational structures, since the teams are military units organized under Tables of Organization and Equipment (TO&E). It is possible, however, for a team to be constituted ad hoc from available personnel (or pools of personnel having various characteristics), perform a single unique mission, and disband, never to exist again. A team formed to investigate a specific civil aircraft accident is an example of this sort of team.

A difficulty closely related to defining criteria for teams is that of specifying criteria for defining a team mission. A great many different activities have been included under the label "team task" in the past, with consequent confusion. Even when a team is definitely identified, many of the activities performed by members of the team (if it is not a one-shot, evanescent team) are not directly related to team missions. For example, members of an assault ribbon bridge platoon (a team under the criteria listed above) may go on a physical training run together. Is this activity a mission? The common-sense answer is that it is not, but for purposes of clarity, some criteria are necessary to bound the "team" activities of a team from other activities that involve members of the team.

Several existing sets of conditions to define tasks or missions were considered for use. No particular one of these stood out as being particularly appropriate, and each set had one or more serious limitations. The following conditions were finally chosen as a practical, working set of criteria for identifying team missions:

- A team mission is a closed-ended or bounded set of activities performed by the team. In other words, there is a definite beginning and end to any set of activities that is to be thought of as a team mission.
- A team mission has a definite, purposeful, and achievable objective or goal. Attainment of the goal is not necessary for the activities involved to be thought of as a mission, but the goal certainly must be reached for the mission to be successful.

- A team mission must require two or more individuals, working toward the same objective, with responsibilities for meeting the objective divided among team members, to perform the mission in a reasonable length of time. Many activities that are team missions could hypothetically be accomplished by a single individual, at an extreme cost in time to perform the mission. For example, one person could construct a log-crib antivehicular obstacle (normally constructed by a Combat Engineer squad or platoon)--in about two weeks of brutally hard individual labor. A competent squad can construct such an obstacle in six hours.

Applying these three criteria to the example presented earlier (the training run), it is apparent that this is not a team mission. The example meets the first two criteria (the training run will be X miles; the goal is to improve the strength and stamina of team members), but fails the third criterion. Any one team member could run the prescribed distance alone in the same time as the team can run it together, discounting differences in fitness.

While these criteria are adequate to differentiate team missions from other kinds of activities, in general, the criteria are somewhat clumsy to apply. For example, when choosing among all the activities performed by members of an Infantry squad to identify missions for study, one might spend a great deal of time identifying the activities performed by the team and applying the criteria to decide which activities are missions and which are not. A more practical means to identify and talk about potential missions is required.

Fortunately, such a means is available. In developing Army Training and Evaluation Plans (ARTEPs), the military missions typically performed by many team types are identified and listed. Many of these military missions meet the criteria above, and are considered team missions. In fact, almost all of the combat-oriented ARTEP missions for the team types studied meet the criteria for team missions.

To permit easy conceptualization in building the model and to avoid misinterpretation, the defined ARTEP missions for the team types that were studied in model building are simply thought of as "the missions." All missions referred to as examples in this report are ARTEP-defined missions or part-missions. The reader should keep in mind the general criteria for a mission (or "team task,") however, for purposes of thinking about teams and missions outside the military context. The criteria are equally applicable to "team tasks" which are encountered in non-military teams.

Team Structure and Organization Concepts

The remainder of this chapter is divided into discussion and presentation of the two critical aspects of the model. The first section presents a set of concepts which can be used to describe and characterize the structure, organization, and other characteristics of a team (or team type), and to describe team missions. The second section presents concepts that are useful in describing the behaviors of teams performing missions.

This separation was not accidental. It is highly likely that, at some future time, it may be possible to predict the behavior of teams performing specific missions from the organizational and structural characteristics of teams and of team missions. With this in mind, it is reasonable to think of two sets of concepts: a potential performance/behavior predictor set--team structure and mission concepts; and a potential outcome set--team behavior and performance concepts. More important, from the perspective of the model, it is vital to have a complete understanding of the concepts of team organization and structure before considering concepts of team behavior, since the discussion of team behavior relies heavily on the concepts of team structure and organization.

Two kinds of team "structure" or "organization" are included in the model. The need for two sets of terms or concepts comes from the fact that there are two kinds of team organization. All of the team types observed to develop this model are "formally organized" teams; that is, the teams exist within an organized hierarchical structure and have an internal structure. The structures that organize these teams derive from Tables of Organization and Equipment (TO&E) of Army units. Under TO&E, all teams of a particular type have the same formal organization, with some minor variations. We term this formal organizational structure "nominal team structure." Nominal team structure of a team does not change.

When performing particular missions, however, teams frequently organize in a different fashion than might be suggested by the nominal structure of the team type. A team may be understrength, overstrength, mission demands may require peculiar or unique skills or procedures, and so forth. Any or all of these factors may cause a team to be organized in a different fashion than reflected by the nominal team structure in order to accomplish a mission. A means was needed to describe the organization of a team as it actually performs a mission, since this organization frequently differs from nominal team structure. The way a team organizes for a particular mission is called "actual team structure." To understand the difference between the nominal and actual team structure concepts, the reader may think of nominal team structure as a potential and actual team structure as an expression or elaboration of that potential.

Nominal Team Structure

Nominal team structure is, simply, a description of the formal organizational characteristics of a particular team type (under TO&E, all teams of a particular type are organized in similar ways). Describing the nominal structure of a team consists of specifying the following characteristics of the composition and organization of the team:

- . Name or title of the team, along with the type of unit in which the team exists.
- . Size of the team (number of members).
- . Positions within the team. Each team member occupies a position in the organizational structure of the team. Two or more team members may occupy positions with identical characteristics, or a team member may occupy a unique position. Position codes or abbreviations may be used to uniquely identify positions. For military teams, each position is characterized by the 5-digit Military Occupational Specialty (MOS) Code and by any important equipment (i.e., primary weapon) associated with the position. Other position descriptions for non-military teams could as easily be used.
- . Hierarchical relationships among team positions. These relationships are based on the chain of command in military teams, but in many cases can be thought of as leader-member subordination relationships. Also, some teams may contain nested teams within their nominal organizational structures. Nested teams are aggregations of positions within a team that can be separately named and identified (such as the Alpha and Bravo fire teams within an Infantry squad), and that frequently perform particular parts of missions independent from the rest of the team.

The above are the only characteristics needed to describe the nominal structure of any team or team type, if the team type is consistently organized. A nominal team structure can be expressed as a listing of positions with notations about hierarchical relationships, or an organization chart. The authors prefer the latter form, since this form expresses the basic information about nominal team structure in a concise way. As examples, the nominal team structures of an Infantry rifle squad and of a Combat Engineer squad are presented as Figures 1 and 2. Unique and replicated positions are indicated in both Figures.

When considering team types, rather than specific teams of a given type, there are a number of characteristics which are potentially useful in discriminating between team types. These characteristics may also be related to differences in the behavior or performance of different team types, the requirements for team training, and other factors.

NOMINAL TEAM STRUCTURE - INFANTRY RIFLE SQUAD (TYPICAL)

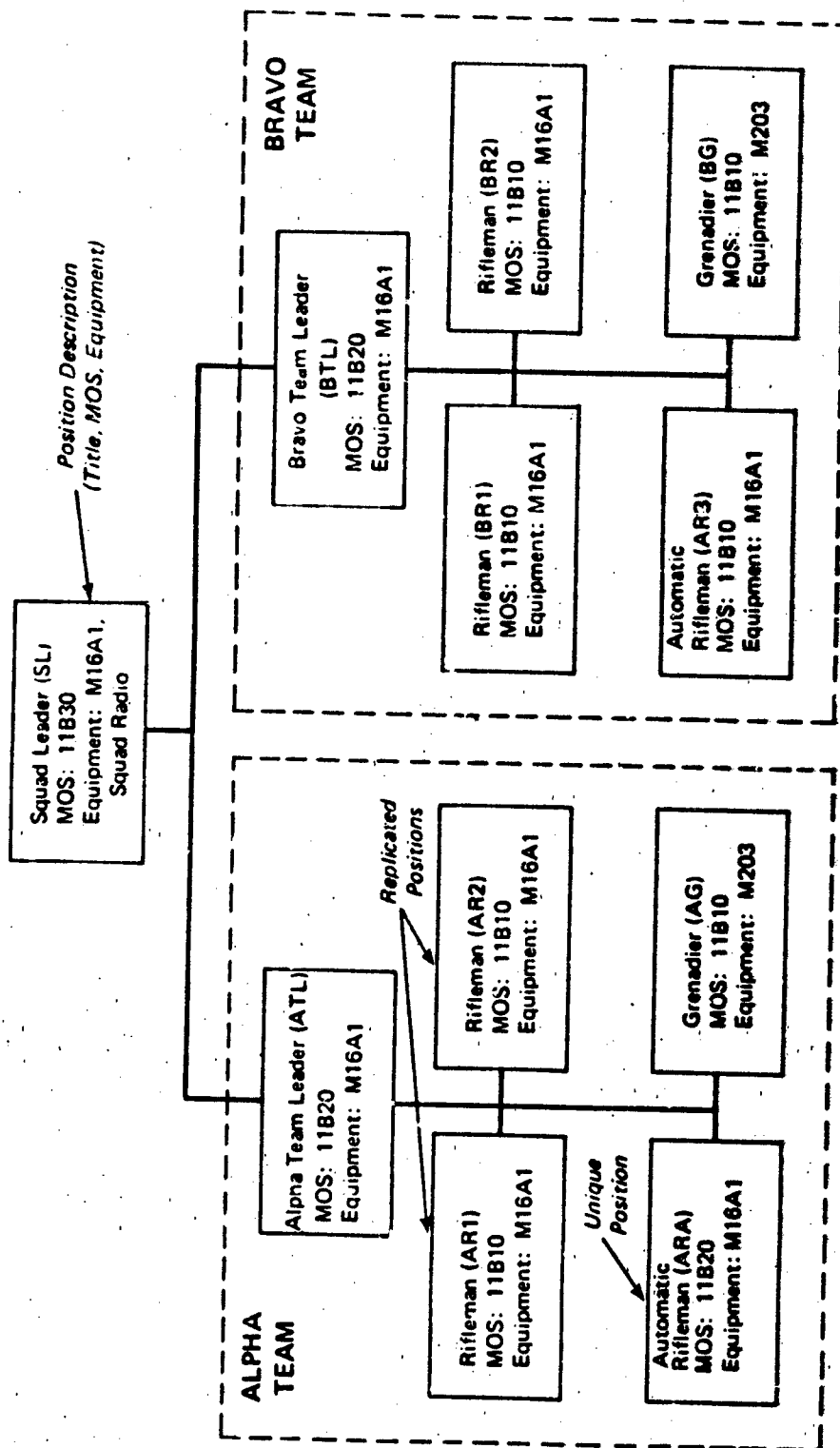


Figure 1. Nominal Team Structure of a Typical Infantry Rifle Squad

NOMINAL TEAM STRUCTURE - COMBAT ENGINEER SQUAD (TYPICAL)

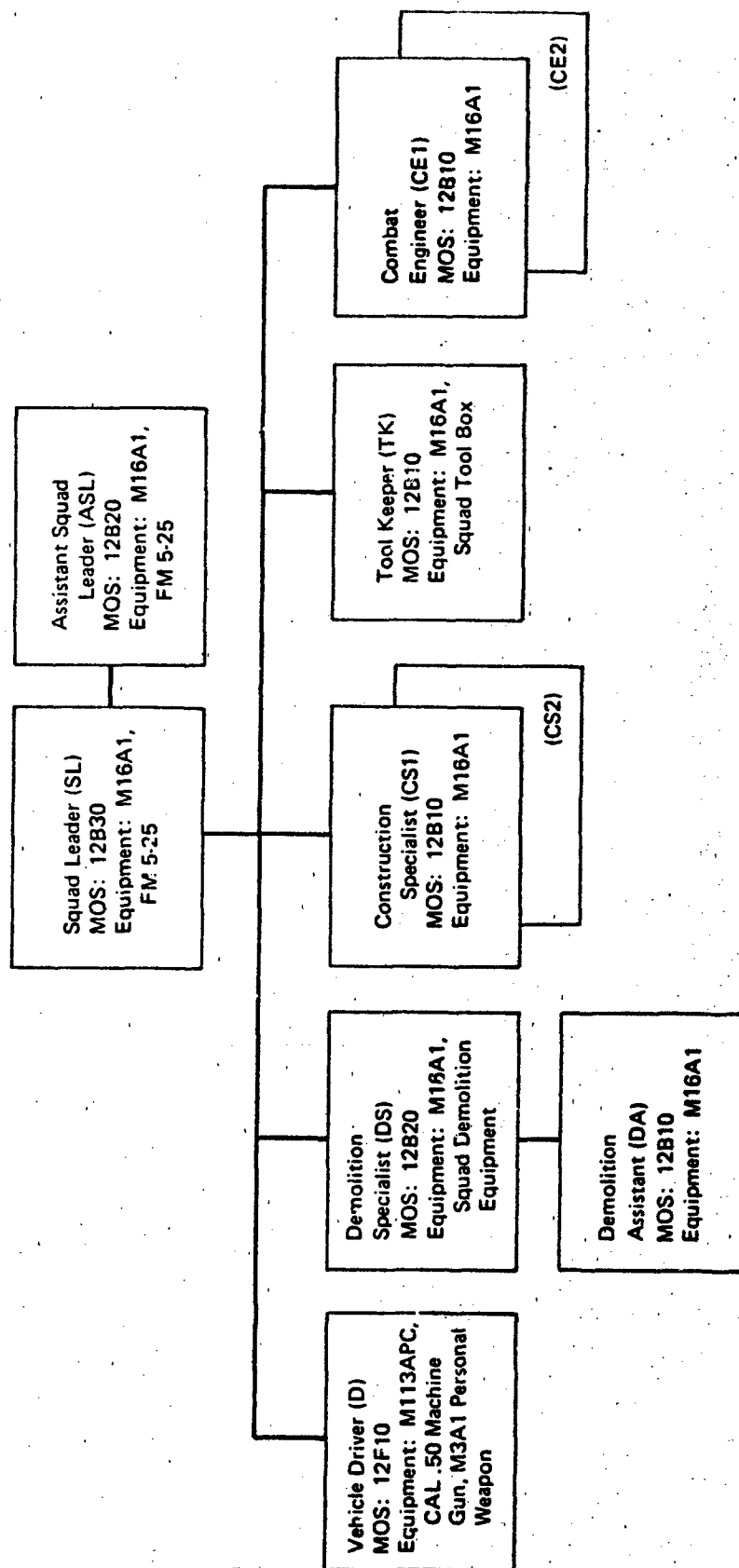


Figure 2. Nominal Team Structure of a Typical Combat Engineer Squad (Mechanized)

Some descriptive characteristics of team types include the following:

- . Mission variety--the number of different missions and mission areas (groups of related missions) to which teams of a given type may be assigned.
- . Prescriptiveness or proceduralization of missions--the extent to which a team type follows well-established procedures in performing its missions, as opposed to having the liberty to perform missions in a variety of ways appropriate to the mission goals and conditions. This characteristic roughly corresponds to the emergent-established dimension of team tasks found frequently in the literature.
- . Equipment dominance of particular team types. Some team types are dependent upon one or more major items of equipment to perform their missions (e.g., tank crews, mortar squads), while other team types are relatively independent of major items of equipment (e.g., rifle squads). This characteristic may be highly correlated with the extent to which missions are procedural versus prescriptive in nature.
- . Environmental reactivity of missions--the extent to which the performance of the missions of a team type are affected by variations in the physical and tactical environment in which the missions are performed. This characteristic may have implications for the nature and variety of team training required for particular team types.

Actual Team Structure

While nominal team structure characterizes team types, or teams out of mission context, actual team structure deals with the way particular teams are organized and structured for particular missions. A description of the actual team structure of a team is, in essence, a description of the way in which tasks and responsibilities that are required for the successful completion of the team mission are divided among the team members. Nominal team structure reflects the latent, or potential, capabilities of team members; actual team structure reflects the actualization of some or all of the potential capabilities of the nominal team.

In nominal team structures, each team member occupies a position, which implies a set of competences and capabilities. The corresponding concept in actual team structure is the role. A role specifies a defined set of task requirements and responsibilities in the context of a given mission.

As in the case of positions, roles may be unique, or they may be replicated in an actual team structure. Like positions, roles are essentially agnostic to the individuals occupying the roles. While the performance of different individuals in a particular role may be quite different, the duties and responsibilities of the role are invariant.

A role, in general, may be thought of as a subset of a particular nominal-team position. The position defines a broad, potential set of capabilities and skills that can be applied to many roles in the context of many team missions. Typically, not all of the skills and abilities that are associated with a position are required to fill a particular role in a given mission. A useful way to conceptualize the relationship of position and role is to think of a position as a "menu" of skills and abilities, and a role as a "meal" selected from the "menu".

Just as many unique meals can be selected from a menu, many unique roles can be constituted from the skills and abilities inherent in a position. Each of the roles is a subset of the capabilities of the position, but different roles may be different subsets of the position. Note that the role "subsets" may overlap. In fact, it is probable that each role embodies a "core" set of skills and abilities of a given position, with a group of particular "peripheral" or "mission-specific" skills and abilities added to the "core" set to compose the skill and ability complex that is required by a particular mission role.

Describing the actual structure a team adopts for a particular mission is very similar to a nominal team structure description, with a few exceptions. A simple actual team structure description contains the following elements:

- . Team type name, plus any specific designations that are appropriate to the particular team being observed. For military teams, this is usually a complete description of the organization of the particular team (e.g., 2nd squad, 1st platoon, B Company, 1/505 Infantry, 82nd Airborne Division).
- . Name of the mission that the actual team structure is adopted for (e.g., hasty attack, construct log crib obstacle, call for fire, etc.).
- . Listing of the number and identification of the roles adopted by team members in the actual team structure, along with MOS and primary equipment.
- . Descriptions of the responsibilities and tasks of each role. These descriptions are typically made at a relatively global level (e.g., the description of the Infantry squad machine gunner's role might be "operate M60 machine gun in accordance with squad tactics"). Task-analytic or behavioral-level

descriptions are not required for a general description of actual team structure, and are not useful at this level of description. It may be that such descriptive detail will be found useful in the context of developing team training, but this speculation has not yet been tested.

- . A description of hierarchial or associative relationships between the various roles, including the description of any nested teams.

As with nominal team structure, a useful method of presenting actual team structure is through the use of organizational charts, adding appropriate (separate) descriptions of each of the roles.

In describing a particular mission context, some information in addition to the actual team structure has been found to be useful. Much of this data is similar to the additional data elements that are used to describe team types, but at a more mission-specific level. The kinds of data that have so far been found useful in describing missions are:

- . Mission goal--what the particular mission is supposed to accomplish as an end result, and any conditions that pertain to the way the goal is to be achieved. A relatively simple, straightforward statement of the goal and conditions is all that is usually necessary. For example, the goal of a reconnaissance patrol mission might be characterized as follows: "Reconnoiter the segment of Bear Creek from map coordinates 495272 to 497252 to locate any points where wheeled or track vehicles might be able to ford the creek. Avoid engagement with any enemy elements encountered; if you take fire, withdraw immediately."
- . Prescriptiveness or proceduralization of the particular mission--the extent to which the mission follows established procedures versus being heuristic or flexible in execution.
- . Equipment dominance of the mission--how dependent the team is on major items of equipment, and which roles are involved with the major equipment items, and in which ways. For example, a Combat Engineer squad installing a hasty protective minefield is not highly equipment-dominant: a compass, a few marking stakes or sticks, a shovel, and some mines are the only equipment required to perform this mission. The same squad constructing tank ditches with bulldozers or front-end loaders would be involved in a highly equipment-dominant mission, since it is not feasible to dig tank trenches without heavy equipment in any reasonable length of time.

- Environmental characteristics surrounding mission performance--the characteristics of the physical and tactical environment which may influence or constrain mission performance. These characteristics include the necessity to utilize chemical-radiological suits and masks, the presence or absence of Opposing Forces (OPFOR) in the mission area, availability of indirect fire or other support, availability of equipment and supplies, team strength, terrain, weather, and illumination (if the mission is performed at night). Any or all of these factors may have influence on the way the mission is performed, or mission outcome.

Team Infrastructure--Nested Teams

It is frequently the case that some defined and delimited subset of the activities and responsibilities required to accomplish a mission is performed by a subset of the team, more or less independently of the rest of the team. The subset performs as though it were a "team within a team," with relatively limited dependencies with the rest of the team. Such an entity is referred to as a nested team. A nested team has many of the characteristics a team at large, with some restrictions:

- A nested team has quasi-independent responsibility for only a subset of the activities and tasks required to accomplish a mission; the team at large is required to accomplish the entire mission.
- The dependencies of a nested team with the rest of the team at large typically occur through only one role (which may be thought of as the nested team "leader"). In a team which does not contain nested teams, dependencies are generally not restricted in this way. The condition of having dependencies channeled through one role is not invariable, but occurs frequently.

Nested teams, in general, meet the criteria established for teams at large earlier in this report, with the exception that a nested team cannot accomplish an entire mission by itself. The activities of a nested team within an actual team structure have a recognizable goal within the mission.

More than one nested team may exist within an actual team structure; in fact, the actual team structure of some teams is a group of nested teams with perhaps only one or two roles not included in one nested team or another. An example of this situation (which also illustrates the nested team concept in general) is presented graphically in Figure 3. This figure depicts the organization of a Combat Engineer squad in the early stages of constructing a log crib obstacle. As Figure 3 shows, the entire squad is organized into three

**ORGANIZATION OF COMBAT ENGINEER SQUAD INTO NESTED TEAMS
FOR A MISSION (INSTALLING LOG CRIB OBSTACLE) -
EARLY PHASE OF MISSION**

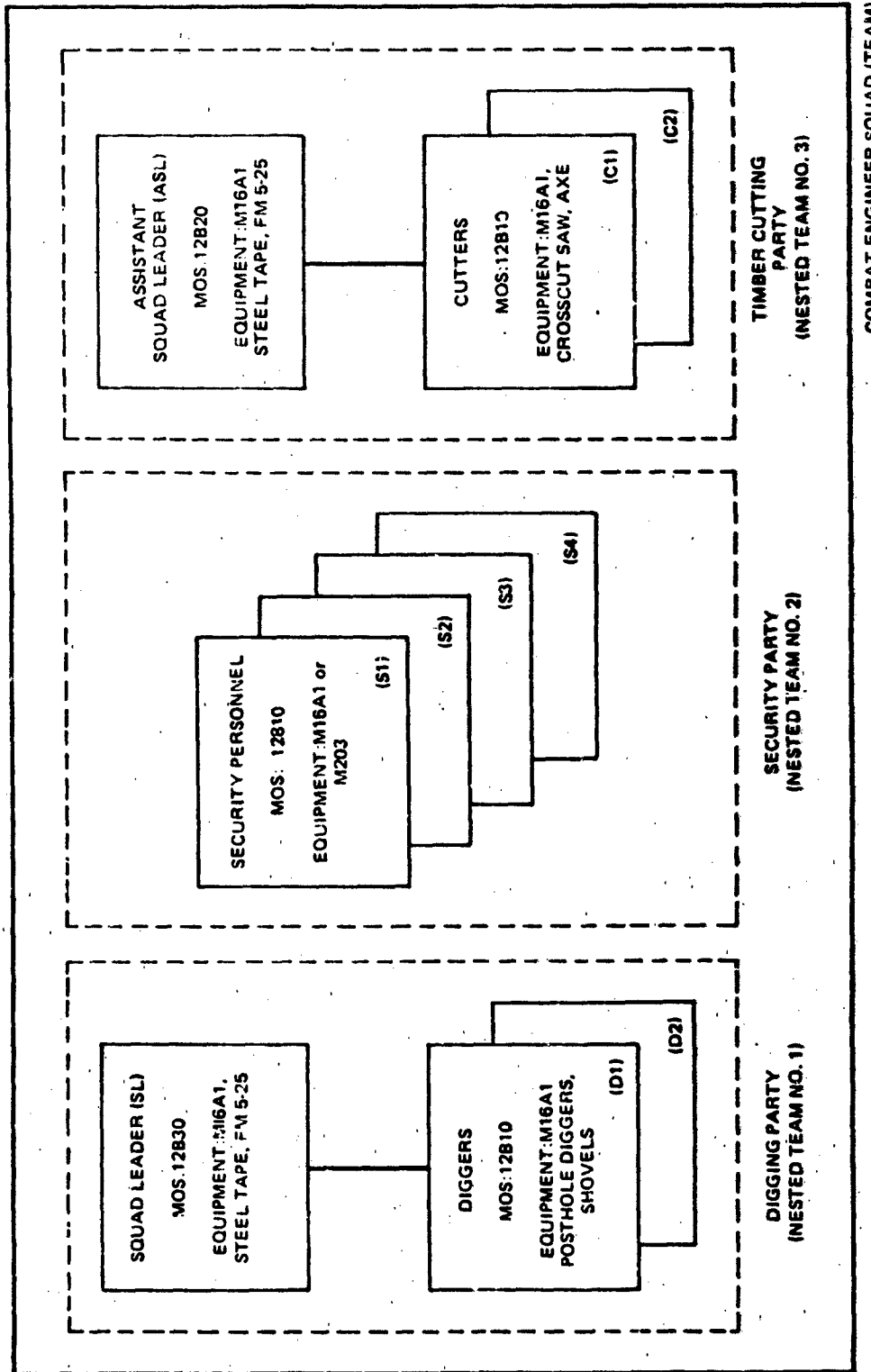


Figure 3. Example of Nested Teams in an Actual Team Structure--
Early Phase of Mission

nested teams, each with its own objective within the mission at large, each operating in a relatively independent fashion. One nested team, supervised by the squad leader, has the objective of preparing the site for the log crib obstacle: digging post holes for the upright logs which will frame the walls of the crib. A second nested team, under the assistant squad leader, has the objective of cutting logs for the upright framing and filler logs to build the walls of the log crib, and for braces. The final nested team has the objective of providing security and surveillance around the site of the log crib. Unlike the other two nested teams, the security nested team is physically distributed (i.e., to cover all approaches from the OPFOR side of the site) and does not have a designated nested team supervisor (in practice, the squad leader provides what supervision is required for the security nested team).

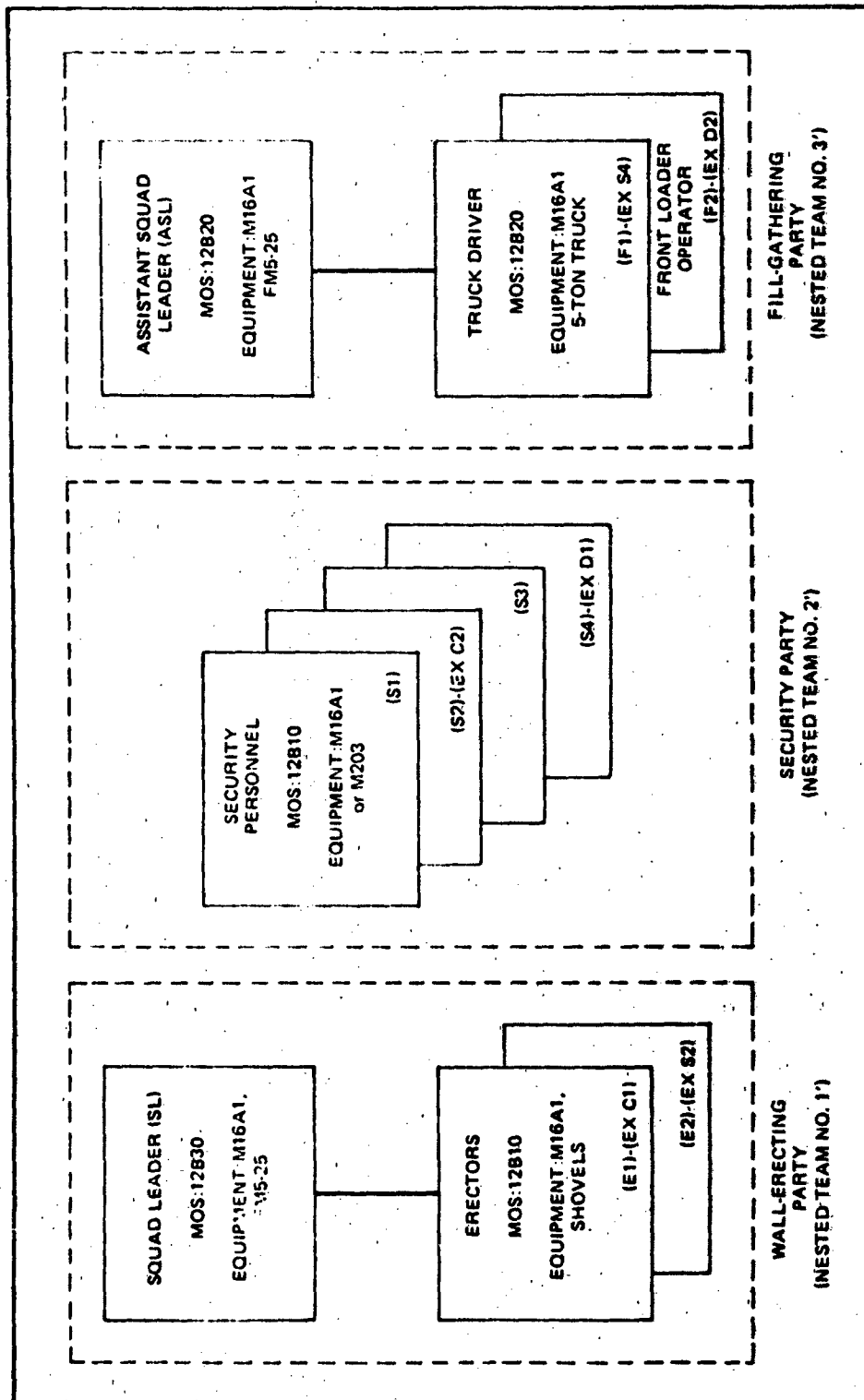
Figure 3 illustrates the two basic characteristics of nested teams. These are:

- . nested teams are elements within a team at large which are organized like teams, but are responsible for only a particular (and defined) subset of the team's mission responsibilities; and
- . the dependencies that the nested team has with other members of the team at large are generally confined to, or channeled through, one member of the nested team, who may be the supervisor of the nested team.

Thus, a nested team is relatively independent of the remainder of the team at large while the nested team is executing its designated responsibilities.

The composition, membership and existence of nested team structures (within an actual team structure) may be static for the duration of a mission (i.e., the nested teams are organized in the same way throughout the mission), or nested team structure may be dynamic, changing at various points in a mission. That is, nested teams may form at one point in a mission, achieve their objectives, disband, and form into other nested teams later, to achieve other mission-related objectives. An example of dynamic nested team structure is provided by the reorganization of the Combat Engineer squad depicted in Figure 3 at a later phase of installation of the log crib obstacle. The altered nested team organizational structure is depicted in Figure 4. Here, both the digging and timber cutting nested teams that existed in the earlier phase of the mission have completed their objectives (all holes dug; and all timber cut, trimmed, and brought to the site). The personnel that were formerly members of those nested teams have now been reorganized into two other nested teams: a wall-erecting nested team which will erect and brace the walls of the log crib obstacle; and a fill-gathering nested team which will gather rock and dirt fill for the log crib. Note also that two of the former members of the security nested team have exchanged nested team membership (and, hence, roles)

**ORGANIZATION OF COMBAT ENGINEER SQUAD INTO NESTED TEAMS
FOR A MISSION (INSTALLING LOG CRIB OBSTACLE) -
LATER PHASE OF MISSION**



COMBAT ENGINEER SQUAD (TEAM)

Figure 4. Example of Reorganization of Nested Team Structure at a Later Phase of the Mission Shown in Figure 3.

with one of the former diggers and one of the former timber cutters (a changed role is designated by "EX" and the abbreviation of the previous role from Figure 3).

This example is also a good illustration of the fact that the role occupied by an individual in a particular actual team structure may call upon different skills and abilities in different parts or phases of a mission. For the purpose of describing a particular individual role in a dynamic nested team actual structure, the roles that a particular individual occupies in the various nested team must be identified in sequence. For example, the role labeled E1 in the wall-erecting party in Figure 4 could be described by the tasks that individual performs: timber cutter/wall erector, or, in the shorthand of the actual structure organization charts, C1/E1. Note that this kind of description is important when dynamic nested team structures are part of an actual team structure: the organization and membership of the various nested teams that exist at successive phases of the mission must be described, and the transitions of individuals from one nested team to another must be recorded.

A final word on the subject of roles and nested teams: no member of a nested team may be a member of another nested team at the same time. In the example in Figure 3, the squad leader was said to be in nominal charge of the security nested team in addition to supervising the digging nested team. When the squad leader temporarily leaves the other members of the digging nested team to check on members of the security nested team, the squad leader changes nested team membership temporarily and becomes a member of the security nested team. When the squad leader returns to supervision of the digging party, he once again becomes a member of the digging party nested team. Admittedly, shifts in dynamic nested team memberships by individual roles, as described, may be difficult to visualize. It is useful to think of the squad leader as a permanent member of one of the nested teams (e.g., digging), and as a shadow or ghost member of the other nested team, occupying a role in the second (security) nested team only sporadically. This could easily extend to the case where an individual is a ghost member of more than one nested team, with primary membership in a single nested team. If an individual is not a primary member of one particular nested team in such a case, however, that individual is not a member of any nested team. This may be illustrated by the case of a platoon sergeant checking on the performance of each of the independently-operating nested teams during the installation of a minefield--the platoon sergeant interacts with each of the nested teams in turn, but does not directly contribute to the objectives of any of the nested teams. Thus he is a member of none of the nested teams.

Up to this point, nested teams have been discussed primarily in the context of actual team structure. It is possible for nested teams to exist in nominal team structure, as well, as mentioned in the discussion of nominal team structure. In this case, the nested teams remain constant across all the missions that may be performed by a

particular team type. While the internal organization of the nominal nested teams may change in response to the demands of various missions, the basic structure and boundaries of a nominal nested team structure do not change. An example of a nominal nested team structure for an Assault Ribbon Bridge Platoon is presented as Figure 5. Here, three nested teams exist within the nominal organization of the team at large. This nominal organization persists across all the missions performed by the platoon, even though the actual team structure of the platoon may change from the nominal nested structure in various missions.

A final point on the subject of nested teams: nested teams may exist at more than one level of nesting. In other words, nested teams may exist within nested teams, to any number of levels of nesting. This situation--multiple levels of nesting--is not likely to occur in numerically smaller team types (e.g., Infantry or Combat Engineer squads), but can be expected to occur in larger team types (platoons, etc.), which have more complex and demanding missions with many internal objectives or goals which must be achieved simultaneously.

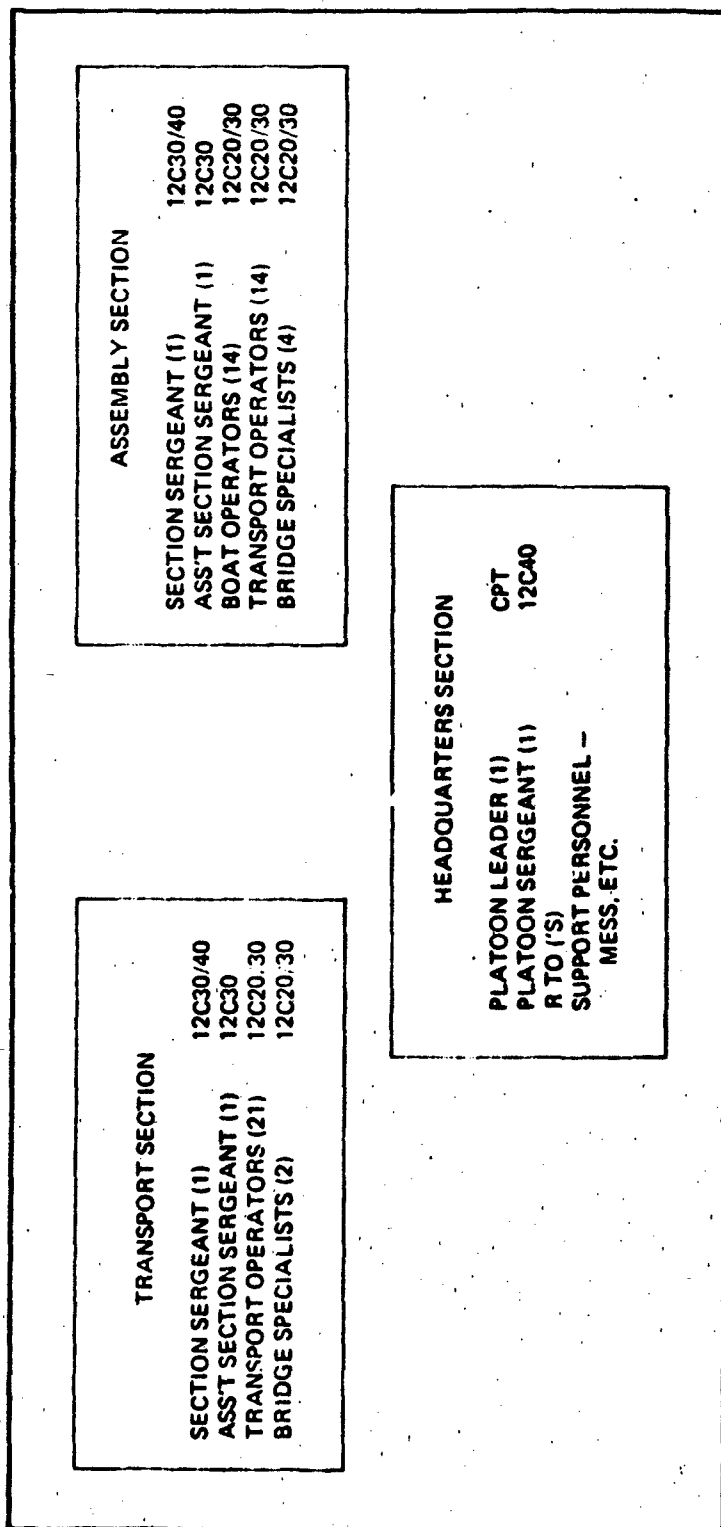


Figure 5. An Example of Nominal Nested Team Structure---
Assault Ribbon Bridge Platoon (Approximate)

Team Behavior Concepts

The previous section presented concepts that can be used to conceptualize both the nominal and actual structure of teams and team types. In addition to the structural and organizational characteristics of teams, it is critical to have a way of meaningfully characterizing the behavior of teams as they perform missions. The ability to describe the behavior of teams in a consistent and understandable way can provide a tool to be used in several important developments, including:

- . a means to evaluate the performance of teams on consistent, valid, and meaningful dimensions;
- . ways to evaluate the commonality of behaviors and characteristics of various teams, to discover important variables which characterize critical differences between team types and their performance;
- . techniques to identify generic and specific training requirements for teams in general, team types, and specific team missions;
- . a theory of team performance which can link and explain characteristics and effects of team organization, structure, missions, and team behavior in a coherent and predictive way.

This section describes a simple, but very powerful, set of concepts for describing the behavior of a team performing any of its missions. As was mentioned in the discussion of the development of the model, these concepts are the result of a synthesis of observation and logical analysis of the behaviors of several types of teams and of missions performed by each team type. The concepts presented are internally complete and coherent (i.e., all of the behaviors of teams and team members performing their missions can be adequately described by using these concepts). However, there is no assurance that these concepts can be used to describe all possible behaviors of all possible teams. With this caution in mind, the following discussion is offered.

The basic premise of this model of team behavior is simply that there are only two kinds of observable phenomena that occur in the performance of any mission by any team: the tasks performed autonomously by the individual members of the team, and the dependency

events that occur between team members. Thus, describing the individual tasks that are performed by each role incumbent and characterizing the dependencies that occur between roles completely describes the behavior of a team performing a mission. Description of individual tasks involved in a team mission is relatively simple; characterization of dependencies is somewhat more difficult.

The concept of dependency is a synthesis of many different attempts in previous work to characterize the ways in which members of teams interact in performing team tasks or missions. Previous investigators have concentrated on such factors of team member interaction as coordination, communication, activity pacing, control, and so forth. For whatever reason, a critical underlying unity in these concepts has remained unrecognized.

This unity is made apparent when the nature and purpose of teams is considered. A team is required to perform a particular task or mission when the number or criticality of activities that must be performed to accomplish the task or mission goal is too great to be accomplished by one person acting alone in a reasonable period of time (recall the previous defining characteristics of a mission). The responsibility for performing the component activities or tasks of the mission is thus divided between two or more people. Since the responsibilities for accomplishing the mission all relate to the common goal, each member of a team is therefore dependent upon other team members, in the global sense that all team members must fulfill their responsibilities in order to achieve the ultimate goal of the team mission. This establishes that there is a global dependency among team members engaged in a particular mission. This would be the only explanatory concept necessary if each team member was able to pursue a defined subset of mission tasks independently, with the successful accomplishment of the mission requiring only that each team member complete his assigned tasks. This may even be the case in some situations.

In the real world, however, team members' tasks frequently require input resulting from the activities of other team members in order that the tasks be completed or initiated. Take, for example, the following two situations in the performance of a fire mission by a mortar squad:

- Dependency for task initiation: The squad leader receives firing data via telephone from a fire direction center. If the squad leader fails to relay this data to other members of the MFS team, the tasks that must be accomplished to get mortar rounds out of the tube cannot even be initiated, since the other team members are unaware that their tasks need to be performed. All of the other team members are clearly dependent upon the squad leader to initiate the various interrelated tasks of laying the mortar and preparing rounds to be fired.

- Dependency for task continuation or completion: One member of a mortar squad, the ammunition handler, prepares mortar rounds by installing and setting the proper fuse and placing the correct amount of propellant charge on each round. If the ammunition handler fails to prepare a round or make the round available to the assistant gunner (who places the round in the mortar tube), the other members of the team cannot continue their individual tasks involved in firing the weapon, even though they may have completed the gun-laying tasks for which they are responsible, independent of the performance of the ammunition handler. The other members of the team are clearly dependent upon the ammunition handler's tasks in order to continue with their tasks or to complete tasks which are suspended pending the ammunition handler's completing preparation of the round.

These examples point out the critical aspect of dependencies, which is that a dependency is basically no more than the provision of input to the incumbent of a role. The input is necessary for the role incumbent to initiate, continue, or complete tasks that are the responsibility of that role. This is the underlying unity behind the wide variety of concepts and explanations of the interactions of team members which have been generated in the past. Team members must provide the necessary inputs on which other team members depend for their individual task performances, when the inputs are needed. In the abstract, the type of input is not relevant, only the fact that the performance of a team member in some way depends on the input.

In the practical, real world of teams, however, it is not sufficient only to establish the existence of dependencies. To be useful, dependencies must be characterized and put in context both of the team mission as a whole and of the tasks of the team members who are involved in dependencies. This means that the sequences of individual tasks of the various team members must be described at some level of detail. This leads back to the basic premise at the beginning of this section: to describe a mission, one must describe individual tasks and dependencies.

During the process of developing this model, a convention for describing and characterizing individual tasks and dependencies was developed. Basically, the individual tasks or activities of each team member are listed side by side on a common scale, preserving the time or phasing relationships between the tasks of each role. Dependencies are entered as links between each of the roles involved in the dependencies. This method allows one to create a time-line picture of an entire mission that includes information about which team members performed which tasks, approximately when the tasks were performed and how long the tasks took, which dependencies occurred between which team members, and how the dependencies relate to the team members' individual tasks. An incomplete diagram of a very simple mission performed by a team of three people is offered in Figure 6 as an

INDIVIDUAL TASK AND DEPENDENCY DIAGRAM OF A HYPOTHETICAL MISSION

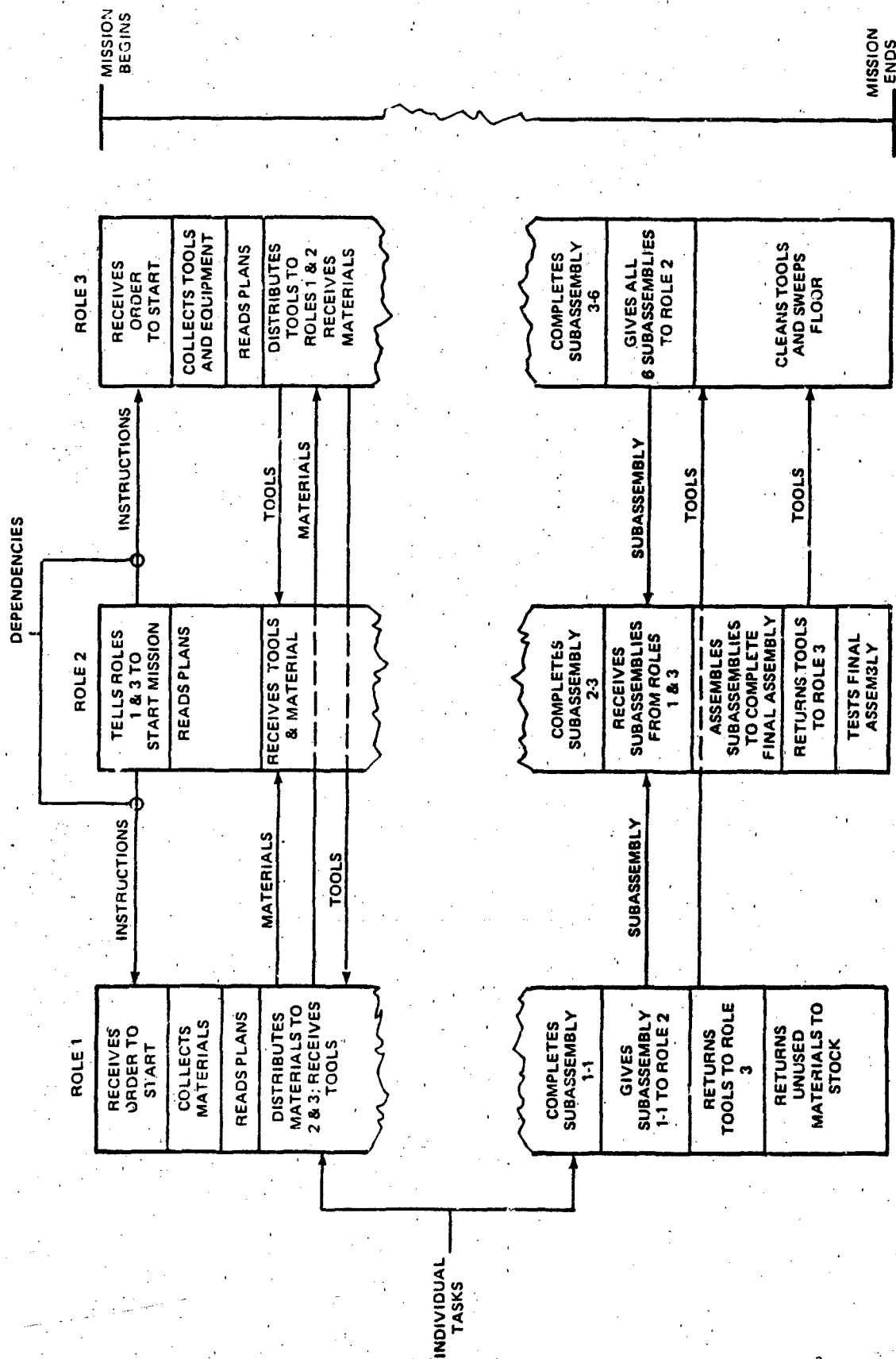


Figure 6. Description of a Hypothetical Mission--Individual Tasks and Dependencies

example of this kind of description. This diagram shows that each team member has several individual tasks and is dependent on each of the other team members for inputs (instructions, tools, materials, subassemblies) that are needed to fulfill his own responsibilities.

It was stated earlier that more than just the simple existence of a dependency between two or more roles must be specified when discussing dependencies. To completely characterize a dependency in a meaningful way requires the following information:

- . identifying the initiator or initiators of a dependency: the role(s) that initiate the dependency, or provide input to another role or roles;
- . identifying the recipient(s) of a dependency: the role or roles that receive the input;
- . identifying and characterizing the type of dependency; that is, classifying the input or dependency element that is provided;
- . identifying and characterizing the purpose of certain types of dependencies;
- . identifying and characterizing patterns of related dependencies (i.e., cases where two or more initiators, recipients, or dependency elements are involved)

Identifying the initiators and recipients of dependencies is a simple process: the roles are listed or identified by some sort of symbols. A convention which has been adopted is to use a flow arrow to show the flow of the dependency element from initiator to recipient in the simple case:

Initiator (I) Element  Recipient (R).

If multiple initiators, recipients, or elements are involved, there is a dependency pattern, for which special descriptive symbols have been developed. Dependency patterns will be discussed in detail in a later segment of this report.

Identifying and characterizing dependency types and purposes can be accomplished in a similar fashion; i.e., simply writing down or abbreviating the kind of dependency element and the purpose that the element serves. In practice, a limited number of type and purpose categories serve to characterize almost all dependencies and patterns that have been observed in creation of this model. The categories and abbreviation symbols that were created for these characteristics, are detailed below.

Dependency Types

In observations made to date, three general classes or types of dependency elements have been identified, each of which is divided for clarity and specificity into two or more subclasses. Each subclass is conventionally considered as a dependency "type" for purposes of the model. Table 2 presents the dependency types and subtypes currently used in the model. Each of the dependency types is discussed below.

Communicative Dependencies. This label is somewhat misleading as, in fact, all dependencies serve a "communicative" purpose; i.e., reduce uncertainty about the next actions of the recipient role(s) or the mission outcome. The title "communicative dependencies" is, however, appropriate, since the primary elements of these types of dependencies are oriented directly toward communication of verbal information, or analogues or signals that parallel verbal communication. Conversely, the "information" conveyed by other types of dependencies are not directly communicative; rather, their message is indirect.

Communicative dependencies are divided into two major subtypes--verbal and nonverbal--and the verbal subtype is further divided, as illustrated in the following discussion.

Verbal communicative dependencies are dependencies in which the information-bearing dependency element is linguistic--i.e., derived from oral or written speech. There are two major types of verbal communicative dependencies:

- . Direct, or nonmediated verbal communicative dependencies (type abbreviation--CD). Dependency elements consist of speech between two or more role incumbents. Equipment (e.g., non-coded voice radio, or telephone) may be involved in the transmission of speech from initiator(s) to recipient(s), but the communication must be spoken language.
- . Indirect, or mediated verbal communicative dependencies (type abbreviation--CI). In this type of dependency, the information in the dependency element is transmitted between initiator(s) and recipient(s) indirectly, or by abstractions of spoken language. Some examples of mediating schemes that are possible are:
 - written messages
 - courier with memorized message
 - wire teletype or telex
 - encoded voice radio messages (e.g., CEOI)
 - computer message-forwarding systems

Table 2

DEPENDENCY TYPES, ABBREVIATIONS, AND EXAMPLES

COMMUNICATIVE DEPENDENCIES – ELEMENT IS INFORMATION

Verbal Communicative Dependencies – Speech or Writing

Direct Verbal (CD)

- Direct speech, voice radio, telephone

Indirect Verbal (CI)

- Written message, courier with memorized message, teletype/telex, computer message systems, Morse code (CW radio, lights, flags)

Nonverbal Communicative Dependencies (CN)

Standard, widely-used signaling systems

- Hand signals, light signals, flag signals

Signal systems unique to particular teams but consistent over missions

- Unique hand signals, formations, body movements, forms of physical contact, etc.

Temporary mission-specific messages

- Shift covering fire on-violet smoke, etc.

PRODUCT DEPENDENCIES – ELEMENT IS PHYSICAL PRODUCT OR COMPLETION OF PROCEDURE OR TASK

Physical Product Dependencies (PP)

- Dependency element is a tangible physical object

Procedural product dependency (dependency element is the completion of a procedure, task, or activity)

Mediated procedural product dependency (P1)

- Procedure performed by equipment but controlled by role incumbent(s)

Nonmediated procedural product dependency (P2)

- Procedure performed by role incumbent(s) using passive items of equipment

VIRTUAL DEPENDENCIES – DEPENDENCY ELEMENTS ARE IMPLIED, MULTIPLE ROLES INVOLVED

Type I Virtual Dependency (V1)

- Identical tasks performed concurrently by several role incumbents acting quasi-independently

Type II Virtual Dependency (V2)

- Collection of related tasks or activities carried out by a group of role incumbents without specific assignment of roles to tasks

- Morse code (CW radio, flags, telegraph, blinker signals, etc.)

Nonverbal communicative dependencies (type abbreviation--CN) are dependencies in which nonlinguistic symbols (gestures, events, etc.) are substituted for linguistic symbols in the information-bearing dependency element(s). On the basis of team behavior observation, three distinct kinds of nonverbal communicative dependencies have been identified. Although they are not separate dependency categories in the model, the three kinds of nonverbal communicative dependencies that have been observed are listed below as examples:

- . Widely standardized and used nonverbal signaling or message systems. These are kinds and systems of signals that are found to be used in a wide variety of team types, missions, and contexts. Some examples are:

- hand signal systems (e.g., tactical movement control signals used in combat, standardized signals used for marshalling aircraft, standard signals used for control of boat movements, etc.)
- light signals (e.g., ships' running and marker lighting protocols, lights used from control towers to control aircraft ground movements)
- flag signals (e.g., mechanized or Armor 3-flag system, etc.)
- other types of widely-accepted nonlinguistic signal or symbol systems

- . Signaling or message systems adopted for general (i.e., across-mission) use by particular teams. These are signals or signal systems that a particular team adopts for its own use or convenience and uses as a regular part of its nonlinguistic communicative protocol. Some examples:

- hand signals unique to a team; e.g., the use of an unusual gesture to indicate the presence and direction of OPFOR, by a particular Infantry squad
- direct physical contact; e.g., tapping vehicle driver on one or the other shoulder or the top of the helmet with a stick to signal change of direction or "stop"
- positions of particular team members with respect to the rest of the team
- movement of personnel
- etc.

- Special signals adopted for particular purposes for one mission only by a particular team. These are agreed-on, prearranged symbols or events that are used to signal or signify specific, preplanned actions. For example, a rifle squad on a movement-to-contact mission may prearrange that the release of a red smoke grenade after enemy contact is a signal to the "fire" team to lift or shift covering fire so that the maneuver team can assault an enemy position without fear of friendly fire.

These categories are adequate to describe and characterize, at a general level, the communicative dependencies that have been observed. It may be that future applications or extensions of the model may require more specific, highly detailed schemes for classifying communicative dependencies to serve particular purposes. When, and if, such expansions or refinements occur, it is suggested that the basic types of communicative dependencies listed above be preserved, and subcategories created, as needed, to maintain a coherent structure for future models or extensions.

Product Dependencies. With product dependencies, the dependency element that passes between initiator(s) and recipient(s) consists of a physical or logical product of the activities of the initiator(s) of the dependency. Dependency types in this class are distinguished by the general type of product--a physical entity (physical product dependency) versus the completion of a procedure or task (procedural product dependency).

- Physical product dependencies (type abbreviation-PP) are those dependencies where the dependency element is a tangible, physical item of some sort. An example of a physical product dependency was provided earlier (the preparation of a mortar round for firing by the ammunition handler of a mortar squad). When the round is made available to the assistant gunner for insertion in the mortar tube, a physical product dependency occurs. Note that not all transfers of physical items from one team member to another during the performance of a mission are mission-related physical product dependencies. For example, one team member may hand his personal weapon to another member during a rest break so that the first team member can use both hands to clean his boots of mud. Handing the weapon to the other team member is not necessary to initiate or facilitate a task on the part of either team member; therefore, it is not a dependency at all (unless, of course, the mud on the boots of the team member who hands the rifle off prevents him from walking or keeping up with the rest of the squad). Careful and judicious observation is often needed to discriminate apparently minor physical product dependencies from incidentals such as that described above.
- Procedural product dependencies are dependencies where the dependency element is the completion of some procedure or task by team members who initiate the dependency. The completion of the procedure or task must be necessary to enable the

dependency recipient role(s) to initiate, complete, or continue tasks or activities for which the recipient(s) are responsible in context of the mission being performed. Procedural product dependencies are divided into two types:

- Mediated procedural product dependencies (type abbreviation-P1) are dependencies where the completion of the procedure or task (the dependency element) is wholly or partially accomplished by one or more active items of equipment. That is, the equipment used by the dependency initiator(s) performs some or all of the procedure. An example of this type of dependency is the use of a fire direction computer (FADAC) by a member of a Fire Direction Center (FDC) team. The operator of the FADAC enters data on target location and altitude and shell type into the computer via a keyboard. The FADAC computer processes the data entered according to a defined algorithm and displays firing data, which are then relayed by the operator to the gun captains (the actual relay of the firing data is a verbal communicative dependency which is associated with the procedural product dependency). The equipment plays an active role in completing the procedure.
- Nonmediated procedural product dependencies (type abbreviation-P2) are procedural product dependencies where completion of the task is accomplished by human action alone, even though the procedure may involve passive items of equipment. For example, an RTO (radio-telephone operator) setting a frequency on a PRC-77 radio so that a platoon leader can communicate with his company commander is engaged in an activity that leads to a P2-type dependency at its completion. Unless the frequency is set properly, communication cannot be established, hence there is a P2 dependency between the RTO and the platoon leader. The radio itself is passive in the procedure of frequency setting. Another example of a P2-type dependency is provided by the interaction between the two fire teams (nested teams) of a rifle squad engaged in assaulting an objective. One fire team (the maneuver team) moves to flank the OPFOR position, while the other (fire team) lays down suppressive fire on the enemy position, but lifts fire (i.e., stops firing) when the maneuver team is in position and ready to assault the OPFOR position. The fire team's fire must be lifted before the maneuver team can assault the OPFOR position. The lifting of fire by the fire team is a dependency which allows the maneuver team to assault without fear of friendly fire. The (collective) dependency initiators are the fire team members, the

recipients (again, collective) are the maneuver team members, and the dependency element is the lifting, or cessation, of fire.

As in the case of communicative dependencies, these categories or types of product dependencies are adequate to characterize all of the product-type dependencies that have been observed in model building. Again, more detailed categorization of types may be required for possible future applications or extensions of the model to particular cases. In describing missions, however, it has been found that identifying the physical dependency element in a PP-type dependency is adequate to describe the dependency. Also, the activities or tasks performed by dependency initiators in P1- and P2-type dependencies often serve to completely specify the kind of dependency elements that exist in these dependency types.

Virtual Dependencies. Virtual dependencies, in addition to being of a distinctly different sort from communicative and product dependencies, are always patterned dependencies (i.e., more than one dependency element is involved). Virtual dependencies exist where the responsibilities of several team members (roles) are apparently identical and the team members are involved in highly similar activities (Type I Virtual dependency), or where several team members share the responsibility for performing a collection of tasks or activities without the tasks being assigned specifically or consistently to the individual roles (Type II Virtual dependency).

The generic term virtual dependency was chosen for this kind of team phenomenon following the same logic as in the choice of the term "virtual memory" in computing jargon. In computing, virtual memory refers to a logical construct: the existence of parts of a computer program or data space which do not have existence in the physical computer memory on a continuous basis. These parts of the program are brought into actual physical memory only at times when they are needed; otherwise, their existence is virtual, rather than actual, in the computer hardware. Thus, the virtual parts of the program are not observable by inspection of the contents of the computer memory at such times.

As with any analogy, this case is only approximate. However, there exists a parallel between computer virtual memory and virtual dependencies: while virtual memory has no physical existence, the elements of a virtual dependency are not observable. In both cases, the "virtual" entity is only implied and must be inferred from other phenomena.

As stated earlier, two types of virtual dependencies have been identified. The following discussion presents the distinction between the two types in detail. Recall that all virtual dependencies are considered to be patterned, and have multiple elements. In addition, all participants in a virtual dependency are considered to be both dependency initiators and dependency recipients.

. Type I Virtual dependency (type abbreviation-V1). In this type of dependency, a single task or responsibility is shared by several roles on a continuous basis. The team members involved in a V1-type dependency perform very similar activities directed toward the same general objective. The classic example of a Type I virtual dependency is an Infantry squad during movement in tactical conditions. In this case, each of the squad members has responsibility to maintain required separation from other squad members (to avoid many people being simultaneously hit by automatic-weapon or indirect fire), and to maintain surveillance of the area around the squad for signs of the enemy. The squad members jointly share the responsibility for maintaining formation and surveillance during movement, providing security simultaneously for themselves and all other members of the squad, on a continuous basis. There is considered to be a continuous dependency element between each pair of squad members, even though no actual dependency element can be observed in this situation (nor in any other Type I Virtual dependency). All of the participants in a Type I Virtual dependency are considered to be both dependency initiators and dependency recipients, continuously.

. Type II Virtual dependency (type abbreviation-V2). This type of virtual dependency is clearly distinct from the Type I Virtual dependency and from communicative and product types. In this case, a number of team members jointly share the responsibility for the completion of a number of related (but not identical) activities or tasks. No specific responsibility for accomplishing any of the group of tasks is assigned consistently to any of the team members who are jointly responsible for completing the task. An example of this type of virtual dependency is provided by the erection of camouflage by members of a TOW crew after the weapon has been set up in place. The crew members jointly have responsibility for setting up camouflage nets, cutting brush, building protective walls around the weapon, etc., but none of these activities is specifically assigned to any one crew member on any consistent basis. Each crew member is aware of what must be done and performs some subset of the tasks required to improve the position, but does not always perform the same subset of the tasks. Unlike the Type I virtual dependency, a Type II virtual dependency does not typically extend over a period of time. Rather, the activities that make up a Type II virtual dependency are generally closely related to one component goal or objective of the mission, as in the case of erecting camouflage discussed above, or in the case of four members of a combat engineer platoon unloading equipment from a truck and establishing mine dumps in preparation for installing a tactical minefield. This last example illustrates one of the common characteristics of Type II virtual dependencies--the activities of unloading the truck and setting up mine dumps is performed by a nested team. While Type II

virtual dependencies are by no means restricted to nested teams, experience has shown that a majority of Type II Virtual dependencies are observed in nested teams, and observers should be alert for Type II Virtual dependencies when nested teams exist (especially in a dynamic nested actual team structure).

While the above discussion has dealt with defining the dependency types which are presently included in the model, it has not made clear the point that a given dependency occurring in a team mission may have two or more parallel elements of different types. For example, an infantry squad leader may simultaneously shout to his troops to hurry, and raise and lower his right fist over his head in the sign for "double time." Here, a single dependency has two parallel elements, each of which conveys the same information, but of different types: a CD (shout) and CN (hand signal). This is a frequent situation not only with respect to communicative dependencies, but with product types, as well. For example:

- the FADAC operator in an earlier example must relay the firing data from the computer verbally to the RTO for further relay to the guns. In this case, the mediated procedural product dependency element (completion of computation by the FADAC) is paralleled by a verbal communicative element-calling out the data to the RTO.
- the ammunition handler in a mortar squad hands a prepared round to the assistant gunner (PP element) and at the same time says "round up" (verbal communicative element in parallel to the physical product element).

While these examples do not exhaust the possible parallel combinations of two or more element types in dependencies, they are typical of those observed in building the model.

Dependency Purposes

Especially in the case of communicative dependencies, but also in other types of dependencies, specifying only the dependency type leads to an incomplete characterization of the dependency. Specifying the dependency type does not, for instance, indicate how a verbal communicative dependency acts to facilitate the task performance of the dependency recipient(s). Recording the content of a communicative dependency element would serve to completely clarify this ambiguity given that the initiator, recipient, and task context were known. When actually observing teams in the real-world performance environment, however, this is impractical, if not impossible (imagine the resources that would be required to capture the exact contents of all the communicative dependencies among members of a combat engineer platoon [team] installing a tactical minefield). Practically, a system is needed to characterize the general purposes of dependencies when the purpose is not obvious from the dependency type (i.e., the purpose of any PP dependency is to make the physical product available to the dependency recipient).

In order to be able to classify dependency purposes when necessary, the purpose categories described in the following paragraphs have been developed. The reader is cautioned that these categories by no means represent all possible dependency purposes. The categories presented here may have some general applicability, but have been specifically developed to characterize dependency purposes of the Army teams that have been observed in development of the model. Work in subsequent phases of this project is planned specifically to expand and make more general the dependency purpose categorization scheme.

The dependency purpose categories currently defined and used in the context of Army teams (and the abbreviations that are used to represent the categories) are:

- . Provide orders, instructions, or directions to (an)other roles(s) [OID]
- . Provide information to an(other) role(s) regarding:
 - status of mission progress or goal attainment (SM)
 - status of individual task activity or completion (SIA)
 - status of personnel (SP)
 - status of supplies (SS)
 - status of equipment (SE)
- . Provide feedback or corrective information to (an)other role(s) (FC)
- . Provide information about the mission environment to (an)other role(s) (IME)
- . Provide information about OPFOR to (an)other role(s) (IMO)
- . Problem-solving or didactic (PS)
- . Provide data to (an)other role(s) (DA)

Some examples to aid in discriminating between each of the categories are:

- . (OID) An infantry squad leader signals to one of his team leaders to circle to the left to flank an enemy position.
- . (SM) The assistant squad leader of a Combat Engineer squad reports to his squad leader that all of the timber needed to construct a log crib obstacle has been cut.

- . (SIA) A member of a TOW crew indicates to his section leader that he needs five more minutes to finish filling sandbags to construct parapets on either side of the weapon position.
- . (SP) A platoon medic reports to his platoon sergeant that only one of three men wounded in a fire fight is seriously hurt and needs to be evacuated.
- . (SS) A squad leader is informed that members of one of the squad fire teams are low on ammunition.
- . (SE) Self-test of a TOW missile control unit reveals to the TOW gunner that there is not sufficient power left in the batteries to fire a missile (Note: this is a type P1 dependency).
- . (FC) An infantry squad leader points out that the members of the squad's Bravo team are walking too close together and directs them to "spread out".
- . (IME) The point man on a squad patrol signals the squad leader that the squad is approaching a danger area.
- . (IMO) During a frag order, a platoon leader indicates on a map the last reported position of an enemy unit.
- . (PS) A squad member suggests a method of bypassing an antivehicular obstacle to his assistant squad leader.
- . (DA) After measuring the width of a bridge, a Combat Engineer calls out the width to his squad leader.

As in the case of dependency types, particular dependencies or dependency patterns may have more than one purpose. For example, in an after-action report to his platoon leader, a squad leader may state that he is low on ammunition (SS), has four casualties (SP), and that the enemy is just over the next hill (IMO). These items of information are all part of the same dependency element, but serve different purposes. Dependencies which embody more than one purpose are typically communicative dependencies.

Internal and External Dependencies

The vast majority of dependencies that occur during a team mission have members of the team of interest as both initiators and recipients of the dependency. In many cases, dependencies that are important to team missions involve persons who are not members of the team as either dependency recipients or initiators. When this occurs, an external dependency is said to occur (when both initiators and recipients are team members, a dependency is called an internal dependency, although the qualifier is not really necessary). External dependencies are

characterized in the same manner as internal dependencies, by specifying initiator(s), recipient(s), and dependency type(s) and purpose(s). Note that external dependencies cannot occur in virtual dependency patterns, and that non-members of specific teams of interest are rarely involved in product dependencies.

Dependency Patterns

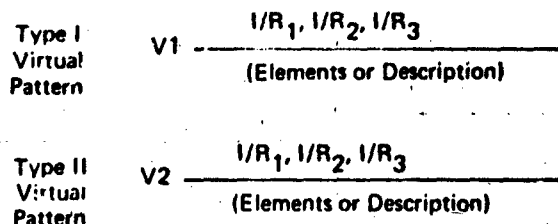
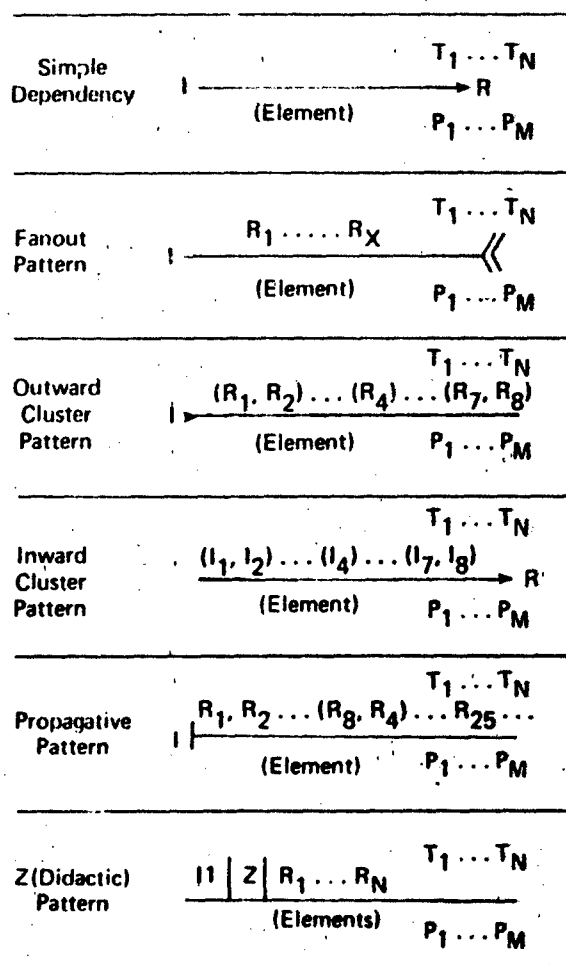
Relatively few dependencies occur in isolation from other related dependencies or have only a single initiator, recipient, and element. The large majority of dependencies occur in related groups, or have multiple initiators, recipients, or elements; i.e., the dependencies occur in patterns. When dependency patterns occur, it is often possible to describe the pattern in lieu of describing each of the dependencies that make up the patterns. Describing dependency patterns does not result in any significant loss of information, at least in the cases of the teams and missions that have been observed and described to date. In fact, there is a significant information gain in describing the dependency patterns that occur in Army teams and missions (in lieu of the individual dependencies), since describing patterns of dependencies tends to bring out complex relationships between roles that are not always apparent when each dependency is described separately. Some dependencies, of course, must be described separate of patterns or in addition to their inclusion in patterns.

While the number and variety of possible dependency patterns are very large, several kinds of patterns have been observed to occur repeatedly in the missions that have been observed to date. In fact, a very few basic kinds of patterns have proven adequate to represent the dependency pattern phenomena that have been observed, and have been adopted as the "standard" patterns for inclusion in the model. This is not to say that there are not other types of dependency patterns which may exist and may prove to be valuable additions to the model. The "standard" patterns which have been adopted have been sufficiently flexible to describe all the dependency patterning phenomena that have been observed to date in Army teams, however.

The "standard" patterns which have been formalized are depicted, along with the pattern symbols that have been developed, in Figure 7. Description of a pattern consists of entering the identification of initiator and recipient roles, dependency types and purposes, and (occasionally) other amplifying information around the symbol for one of the "standard" patterns. Descriptions of each of the "standard" dependency patterns and the characteristics of each pattern are presented in the following paragraphs. The general form of the symbols used to represent dependency patterns is shown below. Specific examples of the way this "basic" symbol is elaborated to represent each of the "standard" patterns are provided in the discussions of each of the "standard" patterns.



DEPENDENCY PATTERN SYMBOLS



I, I_X = Dependency Initiator(s)

T_i = Dependency Type(s)

I1 = Original Initiator,
Z Pattern

R, R_X = Dependency Recipient(s)

P_i = Dependency Purpose(s)

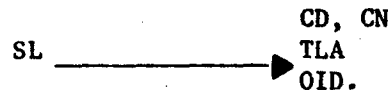
(Element) = Description of Dependency Element (Optional)

(R_1, R_2, R_3) = Grouping of Recipients/Initiators in Cluster or Propagative Patterns

$I/R_1, I/R_2$, Etc. = Participants in Virtual Dependencies

Figure 7. Dependency Pattern Symbols

An example of a simple dependency, not truly a pattern at all, is presented below to introduce the dependency pattern symbols. Here, there is one dependency initiator, one recipient, two dependency type codes (parallel types), and a single purpose. The dependency described is a verbal communicative dependency, paralleled by a nonverbal communicative dependency, between a squad leader (SL) and one of the squad's team leaders (TLA). The purpose of the dependency is orders, instructions, or directions. This "pattern" is represented as:



Fanout dependency pattern. This pattern involves a single initiator role, multiple recipient roles, and one very similar (or identical) dependency element for each recipient role. All the elements need not flow from the initiator to all of the recipients simultaneously, but must occur reasonably close together in time. The classic example of the fanout pattern is the delivery of the frag order for a mission by a squad leader to a squad dispersed in an assembly area. The squad leader moves individually to each member of the squad and briefs the member independently. Very similar or identical dependency elements flow from the initiator (squad leader) to each recipient (squad member). The elements are all of the same type (verbal communicative) and have the same purposes (a frag order has many purposes).

The symbol for fanout patterns is as follows: the initiator role code is placed to the left of the basic symbol line, and the pattern symbol at the right end of the symbol line (arrow in the simple pattern) is replaced by a double left caret (<<). Recipient role codes are placed on top of the basic symbol line. If any of the recipient roles receive the dependency element simultaneously, the codes for those roles are listed together and set off from other recipient roles by parentheses.

Outward cluster dependency pattern. In this pattern, there is a single initiator role, multiple recipient roles, and two or more dependency elements of similar types and purposes, but differing in details of the dependency element content (most outward cluster patterns involve communicative elements). Two or more of the recipients may receive the same dependency element content, but at least one recipient must receive an element different in detail from that received by other recipients. An example of this type of pattern is the assignment of sectors of fire to squad members in defensive positions, by their squad leader. The squad leader (initiator) moves to each foxhole and assigns fire sectors to each man (recipient); each fire sector is referenced to a different set of landmarks, to provide overlapping sectors of fire. The general substance of the dependency element is the same in each case (pertains to limits of the sector of fire), but differs in details of the limits of the sector of fire assigned. The elements of the (verbal communicative) dependency elements are similar, as are the purposes of each of the dependencies.

The symbol for an outward cluster pattern is identical to that of the fanout pattern except for the pattern symbol. The pattern symbol for the outward cluster pattern is an arrowhead pointing to the right, located at the left end of the basic symbol line. The position of initiator and recipient role codes, and grouping of recipient role codes, are the same as for the fanout pattern.

Inward cluster dependency pattern. This dependency pattern is characterized by multiple initiators, a single recipient, and two or more dependency elements that are similar in type and purpose, but differ in details of dependency element content. Similar to outward clusters, many inward cluster patterns are composed of communicative-type dependencies. An inward cluster pattern is exemplified by the receipt of an ACE (Ammunition, Casualty, Equipment) report by an infantry squad team leader. After a general call for "ACE report" each member of the fire team in turn calls out to the team leader the status of his ammunition, whether or not he is injured, and whether he has all his equipment (and if he does not, which equipment is missing). Again, the general content of dependency elements is the same, differing only in detail; and the type and purpose of each of the dependency elements that make up the pattern is similar.

The symbol for inward cluster patterns is similar to that for fanout or outward cluster patterns, with three exceptions. First, the pattern symbol is different: the symbol for an inward cluster pattern is an arrowhead pointing to the right, located at the right end of the basic symbol line (the same as the pattern symbol for a simple "pattern"). Second, the recipient role code is located to the right of the basic symbol line, adjacent to the pattern symbol. Finally, the various initiator role codes are placed on top of the basic symbol line.

Propagative dependency pattern. This pattern involves a single first initiator, a series of recipients who in turn become initiators, and a single dependency element that is "passed down the line"; i.e., the same element moves from the first initiator to one recipient/initiator to the following recipient/initiator, and so forth. Actually, there are as many dependency elements as there are initiator-recipient sequences, but the dependency elements are the same in each case. One initiator in a propagative pattern may provide the same element to more than one recipient, in the fashion of a branching tree. An example of a propagative dependency pattern is provided by an Infantry squad moving in file through thick jungle, each team member following about ten meters behind the man in front of him. To communicate with the rest of the formation, the point man gives a hand signal, which is seen by the next team member in file, who repeats the hand signal. The hand signal is seen by the third man in file, who repeats it for the fourth, etc.

The symbol for a propagative dependency pattern consists of the basic symbol line and a vertical bar at the left end of the basic symbol line. The first initiator role code is placed at the left of

the basic symbol line, and the role codes for other recipient/initiators in the pattern placed on top of the line. If the propagation of the element is other than strictly linear (i.e., one role to the next, to the next, etc), the branching or clustering of roles can be indicated by setting the particular roles in a "branch" off in parentheses. Thus, if the first initiator in a pattern simultaneously transfers a dependency element to two other roles, each of which relays the element to others in a pass-down-the-line fashion, the grouping would be symbolized as: (2,3,4,5,6) (7,8,9), where the numbers are role codes.

Z dependency pattern. This pattern characterizes the successive, reciprocal interchange of multiple dependency elements between two or more roles. A Z pattern has a first initiator, and one or more recipients who later become initiators of dependencies with the first initiator role as recipient. Not all of the recipients of the first element transferred necessarily become initiators of later elements directed to the first initiator. The interchange of elements continues until some criterion is reached. Not all of the dependency elements in a Z pattern necessarily have the same type or purpose. A Z dependency pattern is illustrated by the following: to properly set deflection on a 4.2-in. mortar, the gunner and assistant gunner must alternate in making adjustments to the weapon mount. The gunner first sets the desired elevation and deflection angle on the weapon sight mechanism, then adjusts the pointing of the weapon by traversing the mount until his aiming stakes are lined up in his sight telescope. At this point, he instructs the assistant gunner to "level" the weapon, which is done by adjusting the cross-level knob of the mount until a bubble level is centered. The assistant then calls "check". The process of cross-leveling throws the deflection angle of the weapon off somewhat, so that the aiming stakes no longer line up exactly in the sights. The gunner repeats his adjustments to re-align the aiming stakes, and again calls for "level," which is once again performed by the assistant. This exchange of dependency elements (interpolated with individual tasks) continues until the gunner is satisfied. The gunner then calls "gun up" to the section leader. The successive interchange of dependencies between the gunner and assistant is a Z pattern. While this example illustrates the simplest case of a Z pattern, more complex interchanges are possible. For example, a squad leader's frag order to an assembled squad is frequently interspersed with questions from squad members to the squad leader, which he answers before going on with the frag order.

The symbol for a Z pattern is substantially different from those of other patterns. A major difference is that the role codes of all participants in the pattern are placed on top of the basic symbol line. The role code of the first initiator is placed at the extreme left of the line, and is separated from other role codes by a letter "Z"

enclosed between two vertical bars (the pattern symbol). The role codes for other participants are placed to the right of the "Z" pattern symbol. The role codes of any participants who are only recipients of dependency elements from the first initiator and subsequent other initiators, but never initiate dependencies, are set off in parentheses.

Virtual (complex) dependency patterns. Earlier, it was stated that all virtual dependencies are patterned groups of dependencies. The patterns of virtual dependencies do not generally correspond to any of the "standard" patterns described above. Rather, the patterns of both Type I and Type II virtual dependencies consist of a continuous (virtual) interchange of nonobservable elements between all the roles participating in the virtual dependency. This is termed a "complex" pattern, but not further described. All of the roles in a virtual dependency pattern are simultaneously and continuously dependency initiators and recipients.

Virtual dependencies are symbolized by placing the type symbol (V1 for a Type I virtual dependency or V2 for a Type II) at the left end of the basic symbol line, with the role codes for all of the participants on top of the line. Purpose codes are not entered on virtual pattern symbols. Rather, a brief description of the objective of the virtual dependency is placed below the basic symbol line (i.e., "provide security," or "unload truck--establish mine dumps").

Dependency patterns are a useful way of representing related groups of dependencies, and provide considerable information about the patterns of interaction between the roles of a team performing a particular mission. Taken out of mission context, however, dependency patterns are of little practical use, except as a conceptual tool for thinking about teams, their behavior, and their performance.

MODEL SUMMARY AND DIRECTIONS FOR FUTURE RESEARCH

The model presented in this report is one of two primary research products of the first year of a three-year effort (the second product is a detailed, procedural method for describing team structure and behavior, based on the concepts of the model). A brief summary of the model is presented in Table 3.

This project is one of a related group of efforts, with the ultimate objective of evolving methods and techniques to improve the performance of Army teams through evaluation of team performance and development of team training. As mentioned frequently in the presentation of the model as it exists, the model is by no means final at this time. Efforts in the subsequent years of the project will be directed toward refining and expanding the model and the description method, and toward trial application of the model concepts and team descriptions in two critical areas. These areas are: (1) development of a set of techniques, procedures, and criterion dimensions by which the team performance of teams can be measured and evaluated; and (2) evolution of a method for identifying team training requirements for teams and team types, based on team performance descriptions. In addition, methods and guidelines for selecting team training techniques and procedures for team types will be explored.

Planned developments to this model in subsequent phases of the project include:

- . Expanding and refining of the dependency purpose scheme and incorporating related research findings on team functions to make the dependency purpose categorization scheme more complete and useful;
- . Clarifying the relationships between the various descriptive characteristics of team types and missions;
- . Modifying the concepts of the model, or adding new concepts, to be able to adequately describe team phenomena.
- . Developing an initial understanding of the ways in which team structure, team missions, and constraints may influence team behavior, and incorporating any such relationships into the model.

Adventitious developments of the model may also occur. It may be that, in observing and describing teams to accomplish the objectives of the subsequent years of this work, valuable insights may be made that can improve the descriptive potency of the model or materially add to model completeness. Any such insights will be fully developed and added to the model, along with new concepts and variations on present model concepts that will contribute to the generality and usefulness of this model as a vehicle for studying teams.

TABLE 3

MODEL SUMMARY

TEAM DEFINITION:

1. Two or more person; who are--
2. Involved in a common mission, working to fulfill a common objective; where--
3. Responsibility for performing mission tasks is divided among team members; with--
4. Dependencies among team members.
(teams may or may not have a formal organizational structure).

MISSION DEFINITION:

1. Closed-ended, bounded set of activities; with--
2. A definite, purposeful, and achievable goal; that--
3. Requires two or more individuals, with distributed responsibilities for achieving mission objective, to perform mission in a reasonable time period.

TEAM ORGANIZATION AND STRUCTURE:

Nominal Team Structure: described by:

1. Name of team;
2. Number of members;
3. Position descriptions (e.g., MOS, equipment);
4. Hierarchial relationships among positions (including nominal nested teams);
5. Team type descriptors (missions variety; degree of proceduralization of missions, equipment dominance, environmental reactivity).

Actual Team Structure: described by:

1. Team type name and designation of particular team;
2. Mission name;
3. Number and characteristics (MOS, equipment) of roles;
4. Description of responsibilities of each role;
5. Description of hierarchial relationships among team members, including nested teams;
6. Mission descriptors (goal, degree of proceduralization, equipment dominance, mission environment).

TEAM BEHAVIOR: described by:

1. Individual activities or tasks (associated with roles); and
2. Time or phasing relationships between individual tasks and dependencies, and;

TABLE 3

MODEL SUMMARY (con't)

3. Dependencies: for each dependency (or pattern)--
- Initiator role(s)
 - Recipient role(s)
 - Dependency types (verbal communicative, nonverbal communicative, physical product, mediated procedural product, nonmediated procedural product, Type I virtual, Type II virtual)
 - Dependency purposes (provide information about: orders, instructions, directions, status of individual task activity, status of mission progress, status of personnel, supplies, or equipment, provide feedback or corrective action, information about mission environment or OPFOR, problem-solving, data)
 - Dependency patterns--
 - Fanout: single initiator, multiple recipients, very similar element (same type and purpose)
 - Outward cluster: single initiator, multiple recipients, somewhat similar elements (similar types, purposes, but different content, and provided at different times)
 - Inward cluster: multiple initiators, single recipient, somewhat similar elements (similar types, purposes, but different details of content, and provided at different times)
 - Propagative: single element, passed from one recipient/initiator to the next, and so forth; may "branch"
 - Z: successive interchange of elements between ≥ 2 team members, one member initiates entire pattern, other(s) respond (as in question-and-answer)
 - Virtual (Type I): continuous, mutual interchange of dependency elements between participants, continues over time
 - Virtual (Type II): nonspecified division (ad hoc) of a set of tasks between several team members with no consistency in task allocation over repetitions of the event, or time.

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SECTION 2

TEAM AND TEAM MISSION DESCRIPTION METHOD

Introduction

The first section of this report described the model of team organization and behavior/performance. The purpose of this section of the report is to present the Description Method that accompanies the model. It is no accident that the model of team organization and behavior/performance was described first. The Description Method, presented in this report, was derived directly from the concepts contained in the model. The model identifies those variables or dimensions of team organization and team behavior that are considered important to successful team performance. The Description Method provides a mechanism for identifying and recording those important variables or dimensions in a systematic way, to generate team descriptions (team organization descriptions) and team mission descriptions (descriptions of team mission behaviors).

Before discussing the Description Method, it is necessary to understand how the descriptions produced by the Description Method will be used. It is anticipated that the descriptions resulting from the application of the Description Method will have many useful purposes. These are:

1. The resulting descriptions can serve as a database from which team training requirements can be identified. From the identified requirements, team training programs and materials can be developed.
2. The resulting descriptions can also serve as a database from which team performance measures can be derived. These measures can be used to assess or evaluate team performance, to diagnose team performance deficiencies, and to prescribe team training.
3. The resulting descriptions will be an invaluable research tool. For example, the descriptions can be used to discover how teamwork developed, and to identify critical differences (behavior) between successful and unsuccessful teams.

At this writing, the procedures to analyze the resulting descriptions to identify team training requirements and derive measures of team performance have not been developed. The development of these analysis techniques is scheduled for the second and third years of the project.

This section of the report discusses the step-by-step procedures required to apply the Description Method, and produce team organization descriptions and team mission behavior descriptions. It does not present any procedures for how to use or analyze the resulting descriptions.

Overview of the Description Method

The Description Method is composed of four major steps. These are:

1. Select the team (or team type) to be described (Step 1).
2. Describe the team type organization (Step 2); i.e., describe the nominal team structure.
3. Select the mission to be described (Step 3).
4. Describe each of the selected missions (Step 4). This includes describing the actual team structure used to accomplish the mission, and a description of the team mission behaviors.

Each of these steps are described in detail in the following sections. However, before fully discussing each step, it is beneficial to clarify some important points about the Description Method.

The Description Method is composed of two ingredients. These are:

1. A set of recording forms. These recording forms contain the information necessary to describe the team or team type organizations and the team mission behaviors.
2. A set of instructions or procedures which specifies how the information contained on the recording forms is to be generated (or gathered) and recorded.

The step-by step procedures then describe how and when the recording forms are completed.

To provide an orientation, the next two sections briefly discuss the recording forms and the procedures for gathering the required data. This orientation is provided for several reasons:

1. It is beneficial to realize the kind of data or information that is collected about teams and team missions before discussing each of the four major steps.
2. It is important for the reader to "see" how the required data is related to the ultimate uses of the generated descriptions (i.e., the reader should realize that the data used to describe team organization and team behavior is the kind of data that will be useful in identifying team training requirements and measures of team performance.
3. It is beneficial to realize that the required data is indeed related to the model of team organization and behavior.
4. It is necessary to discuss, in general, how the users of the Description Method will be required to collect the necessary data.

Brief Orientation to the Recording Forms

The Description Method contains eight recording forms. A list of the recording forms is provided in Table 1. The titles of the recording forms provide a hint to the kind of data and/or information that is used to describe team organizations and team behaviors. To gain a further appreciation for the kind of data and/or information that must be generated and recorded when applying the Description Method, Table 2 is offered. This table presents a list of the data items that are contained on the various recording forms, collectively. It should be no surprise that the data items can be organized into three major groups:

1. Those concerning the organizational structure of the nominal team.
2. Data items concerning the organizational structure of the actual team, and
3. Data items concerning the team activities associated with performing a mission (mission specific data items).

It should be no surprise that data items are similar to the dimensions and factors specified in the model of team organization and behavior/performance.

Table 4

List of Recording Forms

FORM 1 - Team Mission Listing
 FORM 2 - Nominal Team Structure
 FORM 2A - Nominal Team Organizational Chart
 FORM 3 - General Mission Information
 FORM 3A - Mission Situational Map
 FORM 4 - Actual Team Structure
 FORM 4A - Actual Team Structure—Nested Team Description
 FORM 5 - Mission/Team Activity Description

Table 2

List of Data Items

Position Titles of Nominal Team Members	Position Title of Actual Team Members
Number of Nominal Team Members	Number of Actual Team Members
Function of Nominal Team Members	Function of Actual Team Members
Equipment Used by Nominal Team	Equipment Used by Actual Team Members
Assignment of Equipment to Nominal Team Members	Assignment of Equipment to Actual Team Members
Existence of Nominal Nested Teams	Existence of Actual Nested Teams
Size of Nominal Nested Teams	Size of Actual Nested Teams
Function of Nominal Nested Teams	Function of Actual Nested Teams

List of Missions Performed by Team
 Mission Goal
 General Mission Procedures
 Non-Organic Support Required for Mission
 Mission Environmental Conditions
 ARTEP Standards
 Sequence of Mission Activities
 Existence of External Dependencies
 Existence of Internal Dependencies
 Dependency Initiators and Recipients
 Dependency Elements
 Dependency Patterns
 Dependency Type
 Dependency Purpose

Brief Orientation to How the Data is Generated

The data generation procedures specified in the Description Method were based upon a validation study of the Description Method. The validation study was partially designed to determine which sources would be the most appropriate to use to generate the required data. Three sources were explored: military documentation, Subject Matter Expert (SME) interviews, and direct observation. The procedures suggested in this report are those which the authors believe will produce the most reliable, usable, and accurate team organization descriptions and team mission descriptions (team behavior descriptions).

It was discovered during the validation effort that no one source was the "best" to collect all the data items. Some sources were "better" for some data items than other sources. Each source had its unique properties with respect to the required data items. As a result, the Description Method presented uses for all three sources (military documentation, SME interviews, and direct observation) at various times. In general, information concerning the nominal team structure is generated by reading military documentation and interviewing SMEs. Actual team structure information is generated via direct observation and interviews with actual team members. The mission specific data is also generated by direct observations of actual teams performing the missions of interest, supplemented by interviews with actual team members. The procedures described herein clearly indicate when and how the various sources are to be used.

It should be clearly understood that the data generation procedures specified in this report are those the authors believe to be the "best"; they represent an ideal. The authors recognize that frequently it might not be possible to obtain the required information from the suggested sources and that an alternate source might be used. Indeed, the required data items can, to varying degrees, be gathered from any of the three sources. However, there are some risks involved when using different sources for specific data items than those recommended in this report. For example, SMEs intend to vary in their perception of mission activities and team behaviors. Thus, if SME interviews are used to generate specific mission information, the resulting descriptions may not be as reliable or as accurate as using direct observation (the recommended source).

If the recommended sources cannot be used, the reader is encouraged to consider the alternative sources.¹ The user is also

¹The current Description Method does not, however, provide guidance on how alternative sources can be used to generate the required data.

encouraged, however, to consider the risks involved in using non-recommended sources.²

Cautionary Notes

It should be clear from the previous sections that the Description Method produces two kinds of descriptions. A team organization description (i.e., a description of the nominal team and actual team organizational structures) and a team behavior description (i.e., a description of the team behaviors required to complete a specific mission). Only one nominal team organization description is required for each team type of interest (for each team type that is to be described), since the nominal team structure is invariant with respect to the missions performed by the team type. On the other hand, one description is needed for each mission that is to be described. Furthermore, an actual team organization description is required for each mission that is described, since the actual team structure may vary from mission to mission (due to understrength or overstrength circumstances). Thus, if ten missions are described for a given team type, the Description Method would generate: one nominal team organization description, ten actual team organization descriptions, and ten mission behavior descriptions.

The step-by-step procedures discussed in this report explain how a single nominal team organization description, a single actual team organization description, and a single mission description is generated or produced. However, it should be realized that the same procedures can be used to generate all the necessary mission descriptions and actual team structure descriptions for a given team type.

It is also necessary to point out that the current Description Method does not contain procedures for summarizing data or information across missions or actual team organizations. That is, if for a given team type ten mission descriptions (and thus the actual team organization descriptions) are generated, the current method does not provide any guidance concerning how the information obtained can be summarized across the ten mission descriptions and the ten team structure descriptions. It is anticipated that such procedures will be developed in the second and third years of the project.

It should also be recalled (from previous discussions) that the current method does not provide guidance on how to analyze the resulting descriptions to identify team training requirements and measures of team performance.

²To obtain an appreciation of the possible risks involved in using non-recommended sources, the results of the validation of the Description Method should be read.

SELECT THE TEAM TYPE TO BE DESCRIBED (STEP 1)

The first step in applying the Description Method is to select (identify) the team type to be described. It should be recalled that the descriptions generated or produced by applying the method can be used for three purposes. Thus, a team type should be selected if there is an interest in any of the following:

1. Identifying team training requirements and constructing team training programs for the team type.
2. Deriving measures of team performance for the team type so that the teams who are members of the team type can be evaluated or assessed.
3. Studying the development of teamwork in the team type.

Step 1 requires performing two substeps. These are:

1. Precisely labeling the selected team type.
2. Verifying that the selected team type is indeed a team.

Labeling Team Types

The Description Method requires a precise definition (label) of the team type. This label must include the general name of the team, the echelon of interest, and any modifiers to name. For example, the following labels are satisfactory: Infantry squads, light, mechanized; Infantry squads, regular, airborne; Infantry squads, light, air assault; Infantry platoons, light, mechanized; Fire Direction Centers, mortar squads; etc. Each of the above labels represent a different team type. The following labels are not satisfactory: Infantry squads, Infantry platoons, mortar squads, etc. These labels are not precise enough and, if used, cause problems and confusion in the remaining steps of the Description Method. The labels must clearly communicate any variation in the general team type name. This kind of precision is needed for several reasons:

1. The missions performed by the various variations of the team may be different; e.g., Infantry (light, mechanized) squads may perform a different set of missions than air assault squads.³
2. The nominal team structure of apparently similar team types may be different.

³It is recognized that there may be many common missions between apparently similar team types, but it should also be understood that there may be some unique missions.

If apparently different team types do not perform different missions or are not organized differently, then it is satisfactory to use the same label for both team types. However, this is the only condition when the same label should be used to describe two team types.

Verifying the Selected Team Type

After the team type has been selected and precisely labeled, it is necessary to confirm that the selected team type qualifies as a team. It should be recalled that the model presents a definition of a team. The selected team type would qualify as a team providing the following criteria are met:

1. The team type selected is composed of more than two individuals. For practical reasons, the selected team type should not be larger than 30 individuals.⁴
2. All the members of the team work together to successfully attain the assigned team missions; i.e., each team member must work toward the accomplishment of the same objective within the mission context.
3. Each team member is assigned responsibilities (individual tasks) within each mission.
4. There are dependencies (as defined by the model) between the various team members.

If the selected team type does not meet each of the above criteria, then another team type must be selected, labeled, and the process repeated.

Comments

To precisely label the team type and to verify that the team type meets the definition of a team requires "knowing" something about the team type; i.e., in order to satisfactorily label the team type, it is important to know that there may be variations among the teams which are generally considered the same team type, and in order to verify that the selected team is indeed a team requires some familiarity with the missions performed by the team. Thus, this first step of the Description Method assumes the user of the method has some degree of familiarity with the team type of interest. If the user does not

⁴If the other criteria are met, but the team type selected is larger than 30 team members, then consider reorganizing the larger team into smaller team types. The Description Method becomes difficult to apply when the team type is large.

possess this sort of familiarity with the selected team type, the following is recommended:

1. Discuss the possible variations of the selected team with an SME or a team member incumbent. A good place to go is to the appropriate branch school for the suspected team type.
2. Obtain any available documentation which might clarify the variations.
3. Obtain and review any ARTEP manuals for those teams which appear to be similar and check the list of missions. Do different variations of the team perform different missions?
4. Obtain TO&E reports for those teams which appear similar, and determine if the teams are comprised of the same position titles.

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DESCRIBE THE TEAM TYPE (STEP 2)

The second step of the Description Method is to generate a list of missions performed by the selected team type and to document the nominal team structure of the two. Three recording forms are completed during Step 2. Form 1 is provided to document the missions performed by the selected team type. Form 2 and Form 2A are provided for recording the nominal team structure and the nominal team organization chart, respectively. The instructions for generating the required information and for correctly recording the information on the recording forms are provided below.

Before presenting the steps involved in completing the forms, it may be beneficial to discuss what data are collected in this step and why. The list of missions performed by the team type of interest is recorded for the following reasons:

1. The list of mission titles is used later in the method, when the missions to be described are selected.
2. The list of mission titles provides an excellent vehicle for understanding what it is the team type really does. That is, the reader of the descriptions generated can survey or review the mission listing and quickly capture the kinds of things the team type does.

The nominal team structure information recorded on Forms 2 and 2A is as follows:

1. The position title of each team member.
2. The MOS code for each position title.
3. The number of individuals holding each position title (thus the size of the nominal team).
4. The likely rank of each position title.
5. The equipment typically used by each position title.
6. A nominal team organizational chart, which shows the hierarchical relationship between each position title (and/or team member) and each nominal nested team (if any).

This information is recorded and becomes part of the generated descriptions for several reasons. These are:

1. The reader of the description can use the recorded information to obtain an immediate picture of the nominal team (particularly the nominal team organizational chart).
2. It should be recalled that the nominal structure is invariant with respect to the missions performed by the team. In Step 4 of the Description Method, the actual team structure is documented. It should be recalled that the actual team structure may vary from mission to mission. It is useful (for both team training purposes and for team performance measurement purposes) to compare the nominal team structure with the actual team structure.

Team Mission Listing (Form 1)

The team mission listing form is composed of two components. These are:

1. A photocopy of the mission titles performed by the team type as found in the appropriate ARTEP manual, and
2. Form 1, which is provided to update the list of ARTEP missions. Form 1 is completed by requesting an SME to review the list of ARTEP missions and to delete or add missions.

The instructions for developing a list of missions and completing Form 1 are as follows:

1. Obtain the appropriate ARTEP manual for the team type of interest. Locate in the ARTEP manual, the list of missions performed by the team type. Be sure to select the list which reflects the appropriate echelon (squad, platoon, section). Photocopy the list and attach it to Form 1.
2. Make arrangements to have an SME review the list for accuracy; i.e., to identify missions which may no longer be performed by the team type and/or missions which may have been recently added to the list. SMEs are the branch schools can be used for this purpose.³ If you are an SME, then arrangements for another SME need not be made.

³For example, if the selected team is Combat Engineer squads, mechanized, then the Directorate of Training Development at Fort Belvoir would be a reasonable place to locate SMEs.

1. TEAM TYPE:	2. PREPARER:	3. PAGE ____ OF ____
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[illegible]

Attach ARTEP Mission Listing

3. Complete Blocks 1, 2, and 3 of Form 1.

- a. In Block 1 enter the label of the team type selected (be precise).
- b. In Block 2 enter your name and title.
- c. In Block 3 enter the date the form was prepared; enter month, day, and year (each as a two digit code--05/19/84).

Your may also find it convenient to record the title of the ARTEP manual used at the bottom of Form 1.

4. Have the SME review the photocopy of the ARTEP missions, and then ask:

- a. Does the team perform any mission not listed?

If the answer is "Yes," then on Form 1 list each of the "new" missions (or the to be added missions) in Block 4. Also place an "X" in the add column of Block 5.

It should be noted that the ARTEP manual usually contains some sort of hierarchy categorization scheme. For example, for Combat Engineers, the missions are divided into Major Mission Operations. Within each Major Mission Operation are a list of missions. In other ARTEP manuals, the term "Major Mission Operations" may not be used, but there will be a major heading of some sort. It seems desirable to record the "added" missions by their major headings. In this way, all the "added" missions within the major heading will be located in the same place on Form 1.

Complete Blocks 6, 7, and 8 for each added mission. In Block 6 enter the SME's name and title. In Block 7 enter the date the "added" mission was identified. In Block 8 enter any other information about the mission that might be useful (e.g., why the mission was added).

- b. Are there any missions on the list which should be deleted from the list; missions which the team no longer perform?

If "Yes," then on Form 1 enter the title of each mission to be deleted. Be sure to use the same mission title as indicated on the photocopy or the ARTEP mission list. Again, the deleted missions should be organized by major heading. After recording each deleted mission, complete Blocks 5, 6, 7, and 8. In Block 5 place an "X" in the second column; the column labeled "DEL." Complete Blocks 6, 7, and 8 according to the instructions provided above. In Block 8 enter the reason why the mission has been or should be deleted from the ARTEP mission list.

You may find it convenient to place a line through the deleted missions on the photocopy. This will highlight the fact that the mission is not performed by the team type.

- c. Has the content of any of the missions or mission titles changed?

If "Yes," enter the mission title (the one appearing on the photocopy of the ARTEP mission list) in Block 4 (and record the "new" mission title in Block 8). If the title has remained the same, but the content or intent of the mission has changed, then record the "new" intent in column or Block 8.

Complete Blocks 5, 6, and 7 in the usual manner.

An example of a completed Form 1 is provided in Appendix B. It should be noted that the missions which were added, deleted, or changed are organized by each Major Mission Operation.

As a precaution or an extra check, it is desirable to repeat the interview with another SME or team member incumbent. The information gathered from the second SME can be recorded on the same Form 1. This is not a necessity, but it can increase the accuracy of the information recorded on Form 1.

Once you have completed Form 1 and attached the ARTEP mission list, you should have an accurate list of all the missions performed by the selected team type.

Nominal Team Structure (Form 2)

Form 2 provides a mechanism to record the nominal team structure of the selected team type. It should be recalled that the nominal team structure is the structure of the team type when it is at full strength

1. TEAM TYPE	3. PREPARER:	5. PAGE ____ OF ____
2. SOURCE(S)	4. DATE ____/____/____	

6. POSITION TITLE & MOS CODE	7. NUMBER	8. EQUIPMENT ASSIGNED OR TYPICALLY USED BY TITLE

(when it is not under- or overstrength). It is the structure represented by the TO&E. Form 2, when completed, will provide an immediate picture of the nominal team structure. It will be useful to compare Form 2 with actual team structure (which is completed later in the method). Form 2 is primarily designed to record the following information:

1. The position title and Military Occupational Specialty (MOS) code of each member of the nominal structure of the team type.
2. The equipment used and assigned to the team type.

Valuable sources to use when completing Form 2 are military documents; e.g.,

1. The Table of Organization and Equipment (TO&E).
2. The ARTEP manual for the selected team type.
3. Appropriate field manuals and technical manuals.

These documents usually contain the required information, but the reader might have to rely on personal experience or consult with an SME to complete Form 2.

The instructions for completing Form 2 are as follows:

1. In Block 1 enter a copy of the label of the team type entered in Block 1 of Form 1.
2. In Block 2 enter the sources that are used to prepare Form 2. For clarity, the following should be entered from each source.
 - a. The exact title of the document(s).
 - b. Any reference number the document(s) might have.
 - c. The date of the document(s).
 - d. The specific page number of the document(s) where the information recorded on the form can be obtained.
3. In Block 3 enter your name and title.
4. In Block 4 enter the date the form was prepared. Enter the month, day, and year (each as a two-digit number).

5. Block 5 can only be completed when it is determined how many pages are required to complete the form.
6. Review the appropriate sources, and determine the number of unique positions in the team type. In Block 6 record the position titles in a hierarchical manner (highest level first).

To the right of the position title entered in Block 6, enter the MOS code of the person who is most likely to fill or occupy the position. The MOS code should be entered as a five position code (e.g., 12B10). In addition, enter the typical rank of the position holder (e.g., E4).

If the position title MOS code, or rank cannot be determined from the documentation, consult an SME or a team member incumbent.

7. In Block 7 enter the number of people in the team type that hold each of the position titles. At the bottom of Block 7, enter the total number of people in the team type. If two or more pages are used to record the position titles, then enter the total number of individuals in the team type on the last page in the box provided at the bottom of Block 7.
8. In Block 8 enter the equipment assigned to each of the position titles. This information may be difficult to obtain from the documentation, since documentation typically does not associate equipment use with the various position titles. For this reason, the following approach should be taken:
 - a. Make arrangements to discuss the equipment assignment with an SME (if you are not an SME).
 - b. Photocopy the list of equipment in the TO&E or other documentation.
 - c. Then interview the SME. Provide the SME with the following instructions:
 - . Review the equipment list, item by item, and for each item indicate who (position title) typically uses the equipment.
 - d. If the SME indicates multiple users of the equipment, then assign the equipment to the various users.

- e. If the SME indicates that the equipment is assigned on the basis of the various missions (i.e., the assignment of equipment varies from mission to mission), then create an equipment category designated "Assigned by mission."

Nominal Team Structure Organizational Chart (Form 2A)

Form 2A, the Nominal Team Structure Organizational Chart, is designed to graphically represent the relationships between the position titles recorded on Form 2 (e.g., the chain of command and/or authority). The instructions for completing Form 3 are as follows:

1. Complete Blocks 1 through 5 in the usual manner. Be sure that the information entered in these blocks is identical to the information entered on Form 1 and Form 2.
2. In Block 6 enter a hierarchical chart of the position titles recorded on Form 2. There should be a block or box diagram which:
 - a. Has the team leader at the top (squad leader, platoon leader, section leader, etc.).
 - b. Shows the relationships between the various position titles. Each position title recorded on Form 2 must be represented. There must be as many blocks (or boxes) as there are total number of team type members (the number of boxes should correspond to the number entered at the bottom of Block 7 on Form 2). These relationships should be represented as lines connecting the boxes together illustrating how the position titles are briefly related to each other. The organizational chart should not be influenced by the missions performed by the selected team type (i.e., the chart should be invariant with respect to the missions performed by the team type).

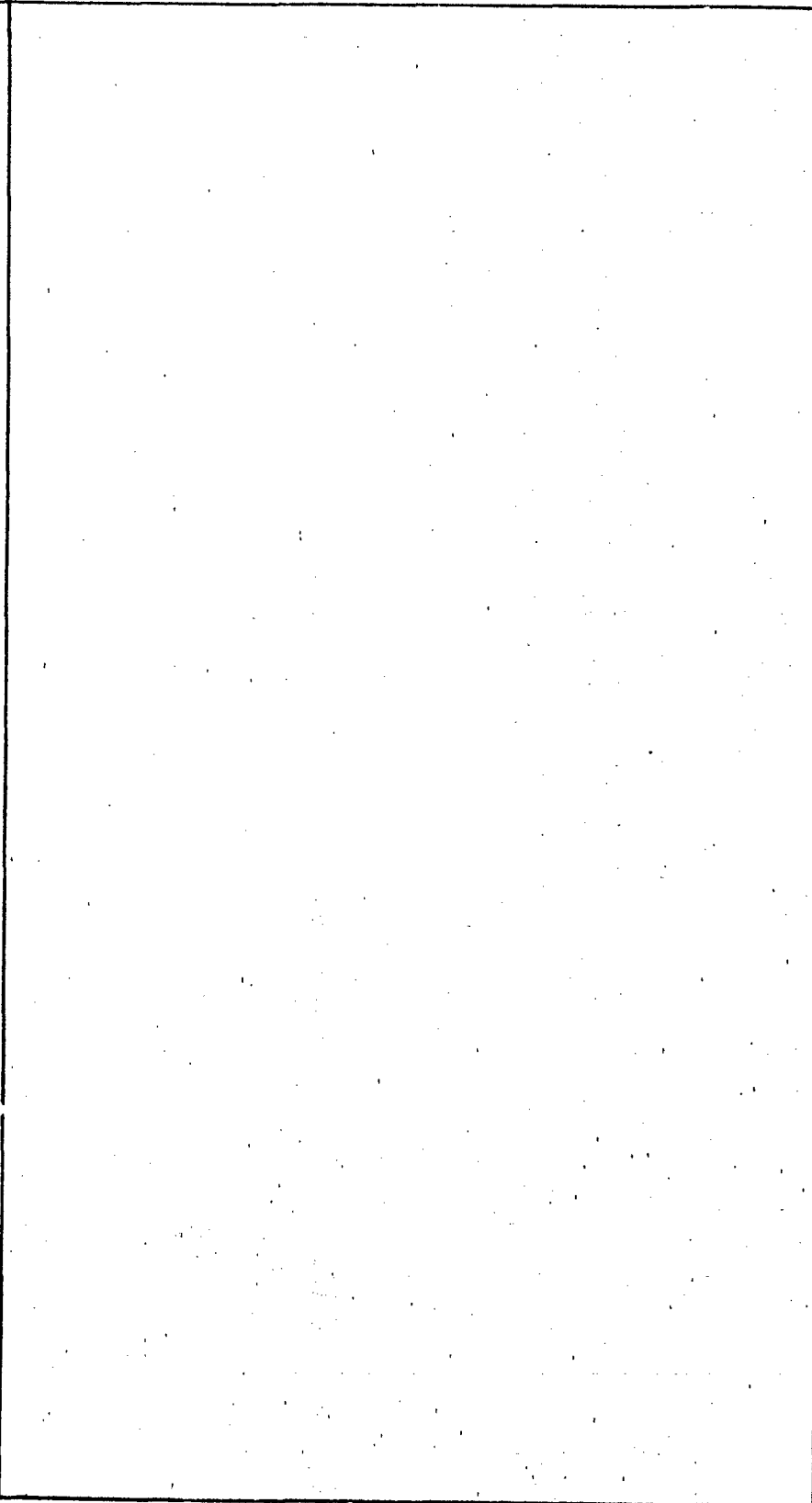
Each of the boxes should be labeled by its corresponding position title--be sure to use the same position titles as recorded on Form 2 to avoid confusion.

The information recorded on Form 2A can typically be obtained from the ARTEP manual or TO&E. You may elect to verify the organizational chart by having an SME review it. Although the basic information is provided in the ARTEP manual and/or the TO&E, you should be made aware that often these two sources do not represent all the position titles encountered in the team type of interest. However, it is usually not

NOMINAL TEAM STRUCTURE ORGANIZATIONAL CHART

FORM 2A

1. TEAM TYPE	3. PREPARER	5. PAGE ____ OF ____
2. SOURCE(S)	4. DATE ____/____/____	

6. ORGANIZATION CHART


difficult to infer the relationships among the team members (position titles) from the information provided in the two sources, particularly if you are familiar with the team type of interest.

Summary of Step 2

Once the three forms (Forms 1, 2, and 2A) of Step 2 are completed, the recorder has what is called a team or team type description. This team type description includes the following:

1. A list of all the ARTEP missions performed by the team type type.
2. A list of the position titles which comprise the team type nominal structure (including the total number of team members in the nominal team).
3. A list of the equipment used by the team type (recorded by position titles).
4. An organizational chart of the team type showing the relationships among the team members.

Notice that all this information is invariant with respect to the various missions performed by the selected team type; i.e., none of the information recorded in Step 2 should be mission specific.

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SELECT MISSIONS TO BE DESCRIBED (STEP 3)

After completing the team type description (the first three forms), the next step is to select the missions that will be described in detail. There are several selection approaches that can be used to select missions to be described:

1. Describe every mission performed by the team type.
2. Select critical missions to be described; i.e., sample from the missions performed by the team type. This approach is probably less precise than the first approach, since errors can be made in sampling.
3. Determine which mission or missions a team type is likely to have problems mastering, and describe those missions.

The following approach is recommended to sample the missions to be described:⁶

1. Make arrangements to interview an SME or an incumbent team type member, preferably the same SME used to complete Form 1. (If you are an SME, this does not apply to you.)
2. Before interviewing the SME or incumbent, carefully review the mission list attached to Form 1. Also review Form 1 for the changes to the list. Be sure the list is relatively up-to-date.
3. Eliminate the missions which you believe can be safely eliminated from consideration. If you are selecting missions to develop team training, some missions which involve generating reports and managing personnel would probably be impacted by team training, and therefore, should be eliminated.
4. Before meeting with the SME or incumbent, read as much as possible about the remaining missions in order to familiarize yourself with them. It is suggested that you read the description of the missions as given in the ARTEP manual. You may also want to obtain specific field manuals to review.
5. Meet with the SME or incumbent. Inform him or her of the missions that have been eliminated from consideration.

⁶The approach suggested has not been verified or tested. It is scheduled to be verified in the second and third years of the current effort.

Review each of the missions with the SME. Have the SME informally rank the missions from high to low on combat importance or criticality. This ranking should not be official, but only an indication of what is relatively more or less important during combat.

6. Starting with the mission that is judged most important (and going to the least important), perform the following steps:
 - a. Review the missions within the Major Mission Operations, and ask the SME or incumbent to rank them in terms of frequency of performance; e.g., how often is the mission likely to be performed during war? The estimate does not have to be accurate. The purpose is to rank order the missions within each Major Mission Operation.

Designate those missions with high, moderate, and low frequencies. This can be accomplished by recording to the left of the mission title, the letter "H" for high, the letter "M" for moderate, and the letter "L" for low (on Form 1).

- b. If you are concerned about developing team training for the selected team type, also ask the SME for a judgment concerning which missions are the most difficult missions to master or to train. Record the SME's response to the left of the mission title with an "D" on Form 1.
 - c. You may also elect to ask the SME for his judgment concerning which missions within the Major Mission Operation involve the most difficult teamwork. The SME, however, may have difficulty in answering this questions for several reasons. These are:

- . Teamwork is a difficult concept to explain, and the SME's perception of teamwork may differ from yours as well as other SMEs.
- . The SME may confuse the difficulty of the individual tasks involved in the mission with the teamwork.

However, if you elect to obtain this information, record the SME's response to the left of the mission title with the letters "TW" (meaning high teamwork), again on Form 1.

- d. Repeat the process with the next Major Mission Operation.

7. At this point, it may be decided to verify the judgments made by the SME or incumbent, since SMEs will vary in their judgments about the missions. Because of this, it may be reasonable to duplicate the above six substeps with another SME or incumbent.

Verification should not be viewed as a necessity. The information provided by the SME is only to provide guidance in selecting missions to be described. Although errors may be introduced if a given SME's judgments are not verified, the seriousness of errors will not be enough to destroy the intent of the effort.

8. When all information has been collected from the SMEs or job incumbents, the missions to be described are selected next. The selection process is somewhat subjective and is done by logical analysis of information obtained from SMEs. The goal of the selection process is to select 10-50 percent of the mission for detailed descriptions, based on the considerations discussed below.

- a. Determine what percentage of the total number of missions the missions indicated on Form 1 represents (divide the number of indicated missions by the total number of missions performed by the team type). If this figure is less than ten percent, you should select additional missions to be described, since describing less than ten percent of the missions performed by a team type will not provide enough data for any purpose except developing team training for single missions.
- b. Determine the amount of time available to describe the mission sample. Describing a typical mission for an average-sized team type will require an average of about 20 hours (four to eight hours of documentation review, four to eight hours observation time, and eight to ten hours preparing the description). This estimate does not include time for liaison, acquiring documentation, or travel for observation. The estimate of the time required for a mission assumes that the preparer is naive with respect to the mission to be described, but not with respect to the Description Method.

Since the average time to describe a mission is about 20 hours, divide the time available for describing missions (hours) by 20. This gives an estimate of the number of missions that can be described in the time available.

- c. Compare the number of missions that you estimated there will be time to describe (in Step b above) with ten percent of the total number of missions performed by the team type. If the time available to describe missions will allow description of less than ten percent of the missions performed, STOP, and consult with your supervisor. Less than ten percent of the missions performed by a team type will probably not be a satisfactory sample for most uses of the descriptions. Your supervisor may elect to stop the effort altogether, or may allow more time for descriptions, or may tell you to describe what is possible in the amount of time available. You and your supervisor must resolve this issue.

If more than ten percent of the total missions can be described in the time available, continue with mission selection. If time is available for more than 50 percent of the missions to be described, it is probably best to restrict the descriptions to no more than 50 percent of the missions. Describing more than 50 percent of all missions performed by a team probably does not add any more relevant information than describing 50 percent of the missions, if the missions are carefully selected.

- d. Select the specific missions to be described. The following general items of guidance are provided to assist in selecting specific missions:
- Select at least one mission from each of the Major Mission Operations. If this is not possible, select missions from the Major Mission Operations that were judged the most important for combat. If possible, select missions from the Major Mission Operations in the same proportion as the distribution of the total number of missions across Major Mission Operations (i.e., if Major Mission Operation "A" contains 40 percent of all tasks performed by the team, then about 40 percent of the missions selected should pertain to Major Mission Operation "A").
 - The missions selected should have the same (or about the same) distribution of low, moderate, and high mission performance frequencies as in the entire population of missions. This frequency guidance must be considered along with the questions of difficulty of mastery of the mission, teamwork involved in the mission,

and the need for systematic training for the missions. In general, the objective should be to prefer missions that are more difficult to master, involve more teamwork, and are judged to require systematic training, while keeping high, moderate, and low mission performance frequencies balanced in the sample. Many missions will not meet all three of these criteria. Where all the missions to be selected do not meet all three criteria, then missions meeting two of the criteria should be preferred in the sample, after the mission that met all three criteria are selected. Missions meeting only one of the criteria should be considered last, if more missions are needed to make up the sample of missions to be described.

Indicate the missions to be described on Form 1 by placing a capital "S" in the left margin next to each mission selected.

9. After the sample has been selected, and the sample is checked against the guidelines, the sample should be reviewed by an SME or incumbent. The purpose of this review is to determine the following issues:
 - a. Are any of the selected missions extremely similar to each other in terms of content and/or teamwork, so that one or more of the selected missions can be eliminated from the sample? The sample should not contain duplicate missions.
 - b. Are the selected missions going to be easy to arrange from an observation point of view? It should be noted that to describe a mission, the mission will have to be observed by the describer. Thus, the sample should contain missions which are consistent with what might occur in a normal field exercise. For example, when developing this description technique, mechanized Combat Engineer Platoons were observed. One of the missions scheduled to be observed was the construction of a log crib. Another mission scheduled to be observed was the breaching of a log crib. These missions were selected because they were consistent and placed fewer demands on the unit being observed. If a log crib was constructed, then it would be relatively easy to arrange for the log crib to be breached as part of field exercise. It should also be noted that constructing a log crib appears under a different Major Mission Operation than breaching a log crib (ARTEP 5-25).

The SME or incumbent might provide some suggestions for adjusting the sample after the review. Make adjustments in the sample by deleting some missions selected and adding other missions not originally selected to replace the deleted missions.

The procedures should provide you some idea of the missions that you want to describe. However, the selected mission list is not carved in granite. When arrangements are made in Step 4 to observe the selected missions, it will be discovered that the mission list may have to be revised, because the cooperating FORSCOM unit (or team type) will suggest other missions (e.g., they may not have the necessary equipment to perform some of the selected missions). Thus, the sample of missions to be observed may be continually modified. It should not be forgotten that the purpose of sampling is to select missions which are representative of the missions performed by the team type.

Summary of Step 3

Selecting the missions to be described depends upon how you plan to use the mission descriptions. If you are developing performance measures, only those missions for which you will develop performance measures will be selected. If you are developing mission specific team training, then you should select only those missions for which team training must be developed. If you are tasked with developing general team training for team type, then you must carefully sample the missions performed by the team type. The sample must be representative of the population of missions performed by the team type. Guidance for sampling missions has been provided in this section.

However, it should be realized that the suggested sampling procedure is not rigorous. In fact, the sampling procedure is rather subjective and is designed to consider possible uniqueness of the team type. The sampling procedures employ subjective judgments based upon the frequency of performance of the missions, the amount of teamwork involved in the missions, the frequency of missions in a combat situation, and need to provide mission training. The sample also selected is moderated by the cooperation and availability of teams to actually perform the selected missions. The list of selected missions may change as the description process continues.

DESCRIBE THE SELECTED MISSIONS (STEP 4).

The last step is to describe in detail the specific missions selected. This is by far the most difficult and time consuming step. However, it is also the step that generates the most useful and meaningful data about the team type of interest. At the completion of Step 2, a limited team type description is generated. At the completion of Step 4, description of a specific team mission is generated.

Step 4 requires the completion of five forms for each mission:

1. General Mission Information (Form 3).
2. Mission Situational Map (Form 3A).
3. Actual Team Structure (Form 4).
4. Actual Team Structure--Nested Team Description (Form 4A).
5. Mission Team Activity Description (Form 5 - many Form 5s will be generated for each mission).

The information for these forms can be derived from three basic sources: military documentation; and/or SMEs; and/or observation of actual teams performing the selected missions. It is not recommended that mission descriptions be generated from documentation alone. Although it is possible to generate mission descriptions solely from reading documentation, the completeness of such descriptions is suspect. Documentation typically does not address or discuss teamwork, and it is the teamwork in the mission that must be described. A useful source for generating mission descriptions which highlight teamwork is SMEs. SMEs sometimes do not agree on how missions are performed or on the kinds of teamwork involved during the mission, but SME interviews add greatly to the descriptions possible only from observation. Observation is recommended, if at all possible, since this is the most complete source of detailed relevant team behavior data.

Preliminary Activities

The first substep of Step 4 is to perform some preliminary planning activities. These are:

1. Make arrangements to observe the mission (and all other selected missions). If at all possible, a specific team of

the team type which is believed to be an outstanding team should be selected for observation. However, this is not always possible. The quality of a specific team is not usually known, and good teams are not always available to be observed. But in spite of these practical limitations, you should try to identify a good actual team of the team type of interest.

Make contact with the selected team and determine when their next field exercise is to occur. Determine what missions are to be part of the field exercise for the selected team. Discuss with the unit which missions will be observed. If necessary, revise your list of missions. However, make sure the revisions do not violate the guidelines that have been provided in Step 3. Also, explain that you WILL NOT be evaluating the teams, only observing the teamwork involved in the performance of the missions.

If more than one mission is to be described, then you must decide whether the same team will be observed for all the missions that must be described. Little guidance can be provided in making this decision. In order to provide some continuity in the descriptions, it seems reasonable that the same actual team should be observed throughout the observation phase. However, in practice, this goal may be difficult to reach. It is not known what effects observing different teams might cause in identifying team training requirements or in the creation of team performance measures.

Similarly, it is not known if more than one team should be observed per mission selected. From a theoretical point of view it does not make good sense to base team type training decisions on the observation of only one team which is a member of the team type. On the surface, it makes more sense to observe a representative sample of teams performing the selected mission(s). This is particularly true if the objective is to develop team training which is appropriate for every actual team that is a member of the selected team type. However, observing more than one actual team performing each mission complicates both the recording and analysis processes. In terms of recording, you would have to record a mission description once for each actual team observed. In terms of analysis, each of the descriptions of the mission would have to be analyzed and a single standard or representative description derived. It is anticipated that the second and third years of this research effort will shed some light on the requirements for the number of teams observed per mission. For the time being, the following is suggested:

- a. Select an actual team of the team type that is believed to be a good team.
 - b. Try to observe the team performing all the missions that must be described.
 - c. If after observing the selected actual team performing the selected mission(s) you feel uncomfortable about the teamwork involved in the mission, then you should repeat the observation process either on the same actual team or on another team of the same type.
2. After making contact with the FORSCOM unit, you should know which missions will actually be observed. For those missions that will be observed, obtain the military documents that describe the missions in detail.

The quality of documentation varies considerably. Some of the available documentation provides sufficient detail to estimate the kinds of teamwork involved in a mission. Other documentation provides only a blanket description of the mission. Thus, you should screen the documentation that has been obtained, and select the documentation that you believe provides the most detail. If you are not an SME, an SME might be able to provide some guidance in selecting the most useful and informative documentation.

3. The documentation should be read carefully. The first reading should familiarize you with the activities and events of the mission. During the second reading, more careful attention should be directed to mission details. Notes may be taken to highlight areas of teamwork which are unclear from the documentation. For example, it is useful to note the following:
 - a. Does the mission require the team to be organized into nested teams or into smaller units or sections? For example, if you are to describe a platoon mission, you need to ask yourself, "Is the platoon organized into squads or parties for this particular mission?" An example of a nested team organization is a mechanized Combat Engineer Platoon, which is organized into four separate parties during the installation of a tactical minefield (a siting party, a marking party, a laying party, and a recording party). Another example is an Infantry squad which is typically organized into two fire teams.

You may not be able to tell from documentation if a nested team organization is used in a mission. Because the documentation may be unclear, the following guidelines are provided. A nested team organization should be suspected if (from the documentation) you determine:

- . The team type is large (e.g., greater than ten).
- . The mission requires several discrete activities to be performed in parallel by the entire team (e.g., a group of soldiers performs "X"; while another group of soldiers from the team performs "Y"; while another group performs "Z," and so on).
- . The team type is naturally organized into smaller units (e.g., platoons organized into squads), and all these smaller units perform the same activities at the same time, but as individual units. For example, in a platoon movement to contact, all the squads are doing generally the same thing at the same time; thus the squads can be considered nested teams.
- . The division of labor in the team requires a subgroup of soldiers to carry out a single duty or responsibility throughout the mission; e.g., a subset of soldiers are required to provide security for the whole unit while the mission is conducted. The soldiers providing security can be considered a nested team, even though they may be spread out and are not physically located close to each other.

If any of these conditions appear to prevail, a nested team organization should be suspected. If the documentation does not make these conditions clear, then you should record in your notes that it is important during observation of the mission to determine if a nested team organization exists.⁷

⁷When you have been tasked with the responsibility to describe a mission performed by a large team (e.g., greater than ten members), it is useful to force a nested team structure. It is difficult to observe a large team, and if the team can be organized into smaller units, then the observation demands become reasonable and acceptable. Thus, when dealing with a large team, try to hypothesize "natural" nested teams, even if the concept of nested teams has to be stretched.

- b. If you have determined from documentation that a nested team organization or structure exists, then ask yourself the following question:

Does the team stay in the same nested team structure throughout the mission, or are nested teams formed, disbanded, and new nested teams formed later in the mission?

You should suspect a stable nested team structure if the nested team is doing the same thing (the same activity) throughout the entire mission. You should suspect a variable nested team structure if any of the following conditions are evident:

- . The size of the nested team appears to change during the mission.
- . A nested team appears not to be engaged in some activity throughout the entire mission (i.e., they appear to perform a set of activities during only a certain segment of the mission, and are not mentioned in the documentation again).

For each nested team identified in the documentation, it is important to determine if the nested team is stable (static) throughout the mission, or dynamic (variable).

If you cannot answer this question from the documentation, record in your notes that it is not certain if the nested teams remain constant throughout the mission or if the nested teams exist for some period of time and are then disbanded. The stability of the nested teams will have to be determined during observation, if it is not clear from the documentation.

- c. If you suspect a nested team structure from the documentation, then you should try to pinpoint the dependencies that occur between the various nested teams. That is, you should try to identify (from documentation), the interactions between the various nested teams. The documentation typically will not make these nested team dependencies explicit. Thus, you must analyze the situation and try to logically derive these dependencies from documentation.

In order to obtain a full understanding of any nested team dependencies, you may construct a matrix in your notes. The rows and columns of the matrix should each contain a label indicating each identified nested team. Only the upper portion of the matrix will be needed. For each cell of the matrix, you should think about the possible dependencies between the nested teams corresponding to the cell in light of the documentation's description of the activities of each of the nested teams. For each cell of the matrix, ask the following questions:

- Is there a product transferred between the two nested teams of interest? If "Yes," then enter in the appropriate cell the product that is transferred.
- Is there a procedural dependency between the two nested teams of interest? You should suspect a procedural dependency if one nested team must perform a set of activities before another nested team can perform its assigned responsibilities (e.g., when installing a tactical minefield, the siting party nested team must complete a majority of their assignments before laying party nested teams can begin their work).

If a procedural dependency is evident, enter a phrase indicating the dependency in the appropriate cell (e.g., "laying party cannot begin until siting party has finished").

- Are there any virtual (implied) dependencies between the nested teams of interest? You should suspect a virtual dependency between nested teams if: (a) there are two or more nested teams which are performing identical activities, but are organized as separate and individual nested teams; e.g., when laying a tactical minefield there may be more than one laying party, or (b) one nested team is providing security, while other nested teams or the team at large are engaged in other activities. If a virtual dependency is suspected, record a phrase indicating the nature of the dependency in the appropriate cell of the matrix (e.g., "nested team 'A' provides security for nested team 'B'").

- Are there any communicative dependencies between the nested teams of interest? Unfortunately, there are probably too many of these to record in the matrix. When reading the documentation, one can imagine many communicative dependencies. In fact, one can speculate that at least one verbal dependency would almost always accompany each of the other types of dependencies.

The matrix process will require careful reading of the documentation and force you to think about the dependencies that might exist between a nested team and all other nested teams. It will also highlight areas to which you must pay particular attention when you actually observe the mission being performed.

- d. When reading the documentation, it is important not only to be sensitive to the dependencies between nested teams, but also about the dependencies that occur between each nested team member within a nested team. You may elect to speculate about these dependencies, particularly those that the documentation does not clearly explain. These notes can also be used to guide your observation of the mission.

You will find it useful to construct a matrix, similar to the one described above for nested teams, to identify the dependencies between the team members of each of the nested teams, one at a time. If there are no nested teams, then only one matrix should be formed, the one for the team itself. You should start with the smallest nested team, the one with the fewest team members. Record, in the cells of the matrix, any suspected dependencies between the nested team members which are unclear from reading the documentation; dependencies which must be clarified during the observation phase. Recall that there are several kinds of team member dependencies to think about:

- Communicative dependencies (e.g., hand signals, verbal instructions, radio communications, etc.).
- Product dependencies (i.e., the transfer of a product between the team members; e.g., the passing of a mortar round, the transfer of mines, etc.).

- . Procedural dependencies (i.e., sequential actions between team members where one team member must perform a set of activities before another team member can begin, end, or continue his or her activities).
- . Virtual dependencies (i.e., implied dependencies--the providing of security, or two or more team members performing the same activities at the same time in order to complete an event or a set of activities).

Remember, in your notes you need not specify every dependency, only those which you feel are unclear from the documentation. You should not be afraid or hesitant to speculate about possible dependencies. The documentation probably will not describe every dependency, and may stimulate you to hypothesize dependencies.

- e. There are certain dependencies which are frequently or commonly "missed" by describers when reading the documentation. Perhaps a discussion of these will assist you:
 - . Type II virtual dependencies. A Type II virtual dependency may exist if the team or a nested team is tasked with the responsibility to perform a set of activities, but specific assignments within this envelope of responsibility are not given. For example, when constructing an assault ribbon bridge, the assembly section (a nested team of the larger team) has many activities which must be performed when attaching a bay to an existing raft. Latches must be thrown, the connecting mechanism must be locked into place, etc. Assembly sections have been observed that do not give specific assignments to specific team members. The team members know what has to be done, and the completion of individual activities is self-assigned. For example, when a bay arrives one team member will throw the latches. He hasn't been directed to do this, but knows it needs to be done and does it. Another team member will self-select himself to perform another individual activity. The self assignment is not consistent (i.e., on one bay a team member may throw the latches, on another bay he may set the dogbones, etc.). This is a form of teamwork which has been labeled a Type II virtual dependency. It

should be suspected when it is believed that every team member or nested team member knows how to perform all the individual activities within a set of activities, and when it is suspected that individual assignments to activities are not given.

- Type I virtual dependencies. A Type I virtual dependency should be suspected when the team members or nested team members are all doing the same thing (the same activity), and appear to be acting individually. The primary example is providing security. A given team member, when providing security, is not only providing security for himself, but for others (who are also providing security). Each team member is dependent upon the others for security or protection. This is indeed a form of teamwork.
- Procedural dependency between two or more team members who are performing identical activities. For example, when laying a tactical minefield, the laying party is assigned the responsibility to dig holes for mines. Frequently, there are four or five team members performing this activity. Typically, the members of the laying party are not assigned specific clusters or holes to dig. One team member will self-select a cluster causing other team members to select other clusters. The clusters are self-assigned. A specific team member works on a cluster that another team member is not working on. They continue this self-selection until all the holes are dug. There is a dependency among the team members in a sense that they coordinate among themselves the assignment of clusters, usually without verbal communication. This sort of dependency is difficult to identify from documentation, but you should ask yourself if this kind of self-selection exists.
- Another dependency which is easy to miss involves performance of a procedure involving electronic equipment where the equipment performs most or all of the procedures.

- f. When reading the documentation you should also take notes on when external dependencies are likely to happen during the mission. An external dependency is a communication or the transfer of a product from a member of the team to someone outside the team; or a communication or the transfer of a product from someone outside the team to someone who is a team member.

Record suspected external dependencies in your notes. During the observation phase you should verify the the existence of these suspected external dependencies. External dependencies should be expected during the following segments of a mission:

- . The issuance of an operations order to the team leader from the next higher level leader (from the team leader's immediate supervisor).
- . The transfer of completed products or procedures at the end of the mission.
- . Status reports between the team leader and his immediate supervisor during the mission.

Thus, external dependencies can occur at any time during a mission.

- g. When reading the documentation, it will not always be clear if a mission activity is an individual activity or a team activity. If you cannot determine this from documentation, you should record in your notes the mission activity, with a phrase indicating that you are not certain if the activity is performed by an individual or by a team. The exact situation can then be determined during the observation phase. Experience has indicated that the following mission activities can be either individual or team activities:

- . The preparation of a report (e.g., a target folder).
- . The lifting and/or carrying of objects (e.g., tools, construction materials, equipment, etc.).
- . The operation of equipment.

- . The loading and unloading of materials from vehicles.
 - . The measurement of dimensions (e.g., using a tape measure to measure a bridge structure).
- h. Also, while reading the documentation you should record in your notes the equipment used by the team. You need not be concerned at this time with assigning that equipment to individual team members, just record the equipment required or used to complete the mission.

Because note taking is so important, this description method contains a note taking guide, called a documentation worksheet. It appears in Appendix A and has been designed to assist you in analyzing the documentation, as well as in recording information about teamwork which is unclear from the documentation. The worksheet need not be used and is not considered part of the formal mission description. You are free to take notes in your own format.

These preliminary activities are designed to help you plan for the observation phase of the mission description process. By following these procedures or activities, you should obtain a good feel for the context and content of the mission that is to be described. It has been found that reading about the mission before actually observing the mission sharpens the observer's awareness. Observers who do not read about the missions before observation tend to generate mission descriptions which are less complete than those observers who carefully read the documentation and prepare good notes.

Determining the Number of Observers

You now need to determine how many observers will be needed during the observation phase. Your understanding of the mission and your notes (or the documentation worksheet) will help you to make this decision. The following guidelines are provided:

1. If the team type is small and the team members are not organized into nested teams, then one observer can adequately make the observation.
2. If the team type is small (five team members or less), and the team is organized into at least one nested team which performs activities simultaneously with the larger team, it is suggested that two observers participate; one observer for the nested team and one for the team at large.

3. If the team type is of moderate size (greater than five members, but less than twelve), then two observers are suggested regardless of the existence of nested teams.
4. If the team type is large (twelve or more team members), then the following formula should be used to determine the number of observers:

$$\text{Number of observers} = \text{Number of Nested Teams} \times 1.2$$

Thus, if the team type has three nested teams, then the number of observers required is 3.8 or approximately 4.0.

These are estimated numbers. You may elect to adjust the estimate based upon your understanding of the mission to be described (particularly your understanding of when nested teams tend to perform simultaneously with other nested teams). The suggested guidelines assume that one observer would not be able to effectively observe two or more nested teams at one time. If the nested teams perform the same activity throughout the mission, then a single observer would be able to observe the nested teams by devoting part of his or her observation time to each nested team. This is only effective, however, if the nested teams do, in fact, perform the same set of activities throughout the entire mission. If this is the situation with the mission you are now considering, then the estimates generated by the guidelines can be cut in half.

Pre-Observation Activities

After completing the preliminary activities, you are almost ready to observe the mission being performed by the selected actual team. Three or four days before the observation, it is necessary to meet with the members of the observation team (if more than one observer is participating). The purpose of this meeting is to:

1. Inform the observers of the mission to be described and observed. It is assumed that the observers are familiar with the description method, but have not yet read the documentation describing the mission. The mission should be described to them in your own words. Explain to them what you believe they will see.
2. Request that each member of the observation team read the documentation that you have already read. Also provide them with your notes or the completed worksheet.
3. Assign each member of the observation team a set of observation responsibilities. Make sure they understand

what they are to observe, and what information they are to gather. Using your notes or the completed worksheet, be sure to point out areas of the mission where the documentation has failed to provide sufficient information about the kind of teamwork involved. It is important that they clearly understand what they are to observe and record.

The observation phase is the most important part of the mission description procedure. It is during the observation phase that critical mission data are collected. After the observation is completed, the data gathered is recorded on a set of forms. The completed forms constitute the mission description. Thus, it is important to plan the observation phase carefully.

The authors recommend that, during the observation, hand-held tape recorders be used to describe the mission, or record important information. Paper and pencil has been tried and found difficult to use in the field environment, particularly if the observer is required to move rapidly with the team or team members. Paper and pencil also do not fare well in inclement environments (precipitation, high winds, etc.). Trying to complete forms during observation does not work. It is more effective to take notes during observation, and then complete the required forms from the notes. Make arrangements, if possible, for hand-held tape recorders.

You should plan to observe the mission from beginning to end, starting with the operations order given to the team leader. For observation purposes, a mission can be thought of as containing the following phases or segments:

1. The preparatory phase. This includes receipt of the operation order by the team leader, planning performed by the team leader (i.e., the decision making involved in determining how the mission will be performed), issuing a warning order, preparing equipment and materials, issuing the order, and rehearsals (if conducted).
2. Execution phase. This includes movement to the location where the mission is to be performed, unloading of equipment, and actual conduct of the mission.
3. Termination phase. This includes reloading equipment, movement back to the original location, and the notification of mission completion.

All phases of the mission should be observed (but not necessarily by all the observers). Experience indicates that it is difficult to observe all of the preparation phase. Typically, the operation order is given for the team leader 12 to 24 hours before the actual mission is to be performed. This is to allow the team leader time to plan the

mission and assess the status of his equipment and personnel. In practice, it is reasonable to start observation when the frag order is issued to team members by the team leader. However, the team leader should be questioned by the observer to determine who delivered the operations order to the team leader, and when. If at all possible, the observer should determine as precisely as possible the content of the operations order, and who (if anyone) assisted the team leader in planning the mission, if the operations order is not to be observed.

On-Site Activities

Before the actual observation of the mission, the following activities should be performed:

1. Meet with the actual team that will be observed. Introduce yourself and the observation team to the team leader. Explain the purpose of the observation (e.g., to obtain a description of mission _____, which emphasizes teamwork). This should occur at least an hour or so before the mission is to begin; the day before the mission is even better.
2. Request that the team leader introduce you to the team members. Count the number of team members in the actual team and record the number in your observation notes. Remember the assistant team leader's name and face (if there is an assistant). If you can recognize the participants by sight, it will be helpful when you are actually observing.
3. After meeting the team members, interview the team leader (platoon leader, squad leader, etc.).⁸ You should obtain the following information:
 - a. When and how the operation order for the mission was issued to the team leader, and who issued it. What was the content of the operations order? Be sure to note that this was not observed, but obtained during an interview with the team leader.
 - b. When and how the warning order was issued by the team leader. Determine if the team leader gathered the soldiers together to issue the warning order, or if the warning order was propagated through the team, member by member.

⁸You should be sensitive to the fact that the team leader may still have a lot of work to do to prepare for the mission.

- c. Who planned the mission? Who decided what activities the individual team members would be assigned?

If the team leader has time, have him explain the mission to you. More specifically, ask him:

- a. What is the goal of the mission?
- b. What are the ARTEP standards for completing the mission?
- c. Does the mission require any non-organic support (e.g., the use of indirect fire, etc.)?
- d. Are there equipment or materials the team is missing or doesn't have that it would normally have?
- e. Is any equipment malfunctioning?

Record the information given to you by the team leader. Again, make sure that you identify this information as being provided by the team leader and not observed.

If the team leader has time, ask him to identify the position titles of each team member. Record the information. If the team leader does not have the time, this information can be collected when the mission has been completed.

Taking Notes During the Observation

By the time you finish asking the team leader the preliminary questions, it will be about time for the team leader to issue the frag order to the team members. From this point, copious observation notes should be taken. In your notes, you should try to capture the following details of the mission:

1. General information about the mission including mission goal, criteria for mission success, environmental conditions, every situation, and equipment deficiencies.
2. A terrain map portraying the situation in which the mission is conducted and locations of personnel and equipment.
3. Description of the actual team structure, including team positions and MOS, number of individuals in each position, equipment assigned to positions, and the mission function of each position.

4. Descriptions of nested team structures (if any exist in the team), including the number, sizes, and functions of nested teams, and how (and when) nested teams are formed and disbanded.
5. Descriptions of the sequences of individual activities of and dependencies among team members and nested teams.

The following paragraphs provide more detail on what to look for (cues and events) during the mission, and suggested ways of recording mission events. Following these suggestions, procedures and suggestions for completing the mission description forms are provided:

1. Record data about the environment in which the mission occurs. A situational map should be drawn, but often the best you can do in the field is to note, in words, the following items:
 - a. The type of terrain (sandy, rocky, etc.).
 - b. The location of trees and other cover (e.g., to the right or left of a bridge).
 - c. The distances between vehicles and troops, the distances between individual team members, the distances between buildings and landmarks (e.g., track is concealed 400 meters from the target bridge).
 - d. The elevations of landmarks (e.g., tree line vs road).
 - e. The location of troops and their direction of movement.

Record any information about the environment which you believe would help you to construct a situational map later on.

2. Record climatic conditions (e.g., rain, high winds, fog, approximate temperature, time of day, etc.).
3. Also record in your notes any discrepancies between the actual nested team structure and the nested team structure you hypothesized from reading the documentation.

When observing, you should record notes about the specific functions performed by the nested teams (if a nested team structure exists). Briefly record the assignments given to nested teams. In your notes, try to capture the objective or goal of the nested team. Also record the number of soldiers in each nested team, as well as their position titles.

For each nested team, determine if the nested team structure is stable or changes in size or membership as the mission progresses. Also record when the nested team is formed and if and when it is disbanded. Clock time is not the critical dimension here, but it is important to record the "when" of an event of action in relation to other mission events. When a nested team is formed or disbanded, try to record the specific mission activity which accompanied the formation or dissolution of the nested team.

4. You should also record in your observation notes any information which would help to clarify misunderstandings from the documentation. For example, if documentation is unclear as to whether a certain action is a team activity or an individual activity, you should clarify the misunderstanding in your observation notes.
5. The most critical items or events to be looking for are internal and external dependencies (i.e., teamwork). Recall that dependencies are events in the mission where one team member is dependent on another team member for input that allows him to start, continue, or complete one or more of his individual tasks. Dependencies are identified by understanding the definitions of each dependency type. In addition, the following guidelines will help. You should suspect a dependency when:
 - a. Two members of the team communicate with each other (a verbal communication or a verbal communication mediated by a radio or some other equipment). Typically these are easy to identify and observe. Verbal dependencies should be suspected when orders, directions, or instructions are given.
 - b. A member of the team uses hand or body signals to direct another team member. Hand signals and body signals are also easy to identify and observe. If a hand signal is observed, be sure you question the team member using the hand signal to determine if the hand or body signal is a standard hand signal, a team hand signal (a hand signal developed by the team and used in every mission performed by the team); a mission specific hand signal (a hand signal specifically developed and used only during the mission being observed). Hand and body signals should be suspected when a vehicle (boat, track, etc.) is being guided into position. Hand and body signals should also be suspected when there is troop movement, and the troops are directed into position or signaled to move into action.

- c. Other forms of non-direct communication are evident (e.g., smoke signals, light signals, audio signals, [non-speech], etc.). Again, question the user of these signals to determine if they are standard, team specific, or mission specific.

Smoke signals, light signals, and audio signals are typically used to signal the start or finish of some action or event during the mission. Dependencies involving such signals can usually be detected by noting the signal (e.g., by observing the smoke).

The task of the observer is to note the signal and associate it with some event or action that is taking place (e.g., flanking movement of a fire team).

- d. Two or more team members pass or transfer a product or object (e.g., a mortar round, a piece of equipment, etc.). Typically, these kinds of dependencies are identified by first noticing the product. When an observer first sees an object or product, he or she should suspect that the object or product will be transferred between team members, and they should anticipate the dependency. As an observer, you must be alert and attentive to all the objects that you observe, since they in fact may involve a dependency at some point during the mission. Do not dismiss any object from being involved in a dependency or transferred between team members, regardless of how incidental the object might appear. For example, the object might be a piece of paper or a pencil. All objects observed during a mission have the potential to be involved in a dependency, the potential to be transferred between team members.

Although it is true that not all products or objects that are transferred between two or more team members are, in fact, product dependencies (for example, handing another team member a rifle so that one team member can use both hands to adjust his splice gear is probably not a product dependency) looking or observing for a transfer will enhance your ability to identify dependencies and teamwork.

The transfer of a product or object should be suspected when:

- The team itself is manufacturing or making the product (e.g., when a charge is being placed on a mortar round).

- . Equipment and material are being loaded or unloaded.
- . Tools are needed to perform the mission (e.g., shovels, hammers, chainsaws, etc.).
- e. Two or more team members are engaged in an activity and appear to be working together. Typically, this situation involves either or both procedural dependencies and virtual dependencies. During the observation, you need not decide which type of dependency is involved. Your first concern is to describe the observed team work in sufficient detail that the type of dependency can be determined when the observation has been completed.

These types of dependencies are difficult to detect and observe, since they typically do not involve verbal communication or a product (object). Two team members working together to lift an object can usually be detected by noting the object and not the teamwork. When an object is not involved, the teamwork is more difficult to identify. For example, when installing a tactical minefield, the fusers and armers stay a safe distance from each other. No object is involved, but teamwork is involved.

Only a little guidance is available for detecting these forms of teamwork. The guidance is:

- . Observe or look for sequences of actions. If you notice that the mission has a definite sequence, then you should suspect some sort of teamwork among those people assigned the responsibility to perform each of the sequences.
- . Observe or look for one team member assisting another team member (e.g., one soldier holds a metal stake while the other hammers the stake into the ground). These might be detected if the observer is looking for a product or an object (stake and hammer), but they may also be identified by observing two people working together or two people who are in the same space or area. When two or more people are in the same area, you should suspect some sort of teamwork or dependencies. You should move to the area and observe closely.

- . Observe or look for a situation where a group of individuals (or a nested team) has been assigned a task to perform, but no individual assignments within the nested team have been given. Typically, these situations require some sort of teamwork between the nested team members in order to complete the nested team assignment.
- . Observe or look for a situation where two or more team members are manipulating or controlling a piece of equipment or a large object. For example, when constructing a ribbon bridge, several team members (assembly section) perform a set of activities together, all directed toward a single bay. Often they appear not to be working as a team, but close observation will reveal that they are.
- f. Two or more team members are providing security. Security is a form of a dependency (teamwork), and should not be overlooked because no products are transferred. Actually, a service is transferred, but security is common enough to be called out specifically as one of those forms of teamwork you should look for and record.

Thus while observing, you should look for evidence of teamwork. More specifically, look for:

- a. Two or more team members conversing with each other.
- b. Hand signals and body signals.
- c. Smoke signals, light signals, or audio signals.
- d. Objects being transferred among team members or nested teams.
- e. Team members working in the same space or area (typically this is an indication that teamwork is happening).
- f. One team member assisting another.
- g. The provision of security.
- h. Occasions where team members appear to be working individually.

- i. Occasions where everybody appears to be doing the same thing.
- j. Occasions when one group or nested team must perform a set of activities before another group or nested team can start their activities.

If you observe these kinds of things happening, you should immediately suspect some sort of teamwork and move closer to observe the event in more detail. After observing the event closely, determine if there dependencies occur, and record their occurrence.

6. After identifying a dependency (teamwork), what information about the dependency should you record in your observation notes? If you observe what you believe to be a dependency (an instance of teamwork), you should record the following items about the dependency in your observation notes:

- a. The initiators of the dependency. Who started the dependency. Do not record names; record the position titles (squad leader, combat engineer, demolition specialist, etc.). If two or more positions have the same title, it is useful to distinguish the positions by number (e.g., rifleman #1, combat engineer #6).
- b. The recipients of the dependency. Who received the communication, the product, or the service. Again, record the position titles of the recipients. Be aware that there may be more than one recipient.
- c. The pattern or flow of the dependency (i.e., how did the product, communication, or service flow from the initiator to the recipient[s]). If there is only one recipient, then the pattern is not important. However, if there is more than one recipient, the pattern is important. The model of team performance/behavior suggests several patterns (e.g., fanout, cluster, propagation, etc.) You should become familiar with the patterns before you begin the observation. It will make recording patterns easier if you can use one of the pattern names. Patterns are summarized in Figure 7 of the model in Section 1.

It is not essential to describe the patterns here, since they are adequately described in the model. However, two important aspects of dependency

patterns will be mentioned here to refresh your memory when recording observation notes. These are:

- . Almost any pattern described in the model can take on the form of a "Z" pattern. In your observation notes, it is important to identify the pattern, as well as record if the pattern assumes a "Z" form. A "Z" pattern or formation occurs when the recipients of the dependency communicate back to the initiator.

For example, when a frag order is given, the recipients may ask questions of the initiator. This makes the frag order dependency have a "Z" pattern. A "Z" pattern should also be suspected when team members are trying to align or position a vehicle using hand signals.

- . When more than one recipient is involved, it is important to note if the recipients receive the dependency as a group (all at the same time) or as individuals. This distinction is critical. For example, when a warning order is issued, the team leader may call all the team members together and issue the order in a group setting, or he may "see" each team member individually. This is a fanout pattern in both cases, but it is important to record, in your notes, if the fanout pattern was individually or group structured.

- d. The dependency element or what was transferred. Describe in your observation notes, exactly what took place between the initiator and the recipient(s). For example, if a hand or body signal was given, describe the hand or body signal, and its purpose. Record, if possible, if the signal is standard, team specific, mission specific.

If a verbal communication is given, indicate in your observation notes the content of the communication (e.g., if you observe an operation order being issued, you should record the content of the order, such as the purpose of the mission, the chain of command, the enemy situation, actions or enemy contact, location of other friendly troops, etc.).

If the dependency involves the transfer of a product, record the product that was transferred. Also, describe its state (e.g., "mortar round fused and charged").

If a service was involved, describe the service; e.g., security provided, bay assembly completed, etc. Be as detailed as possible in your notes. Describe the service as precisely as possible. If the service is not evident, describe the actions or events you believe to be the service.

- e. The purpose of the dependency. Record in your observation notes, what you believe is the purpose of the dependency. The model of team performance/behavior contains a list of dependency purposes. This list should be read and understood before actually conducting the observation. It should be noted that any given dependency can have more than one purpose.

During the observation, if you cannot either remember the list of specified dependency purposes or if you cannot determine the purpose from the observation, describe the circumstances surrounding the dependency in as much detail as possible. This will help you later to determine the dependency purposes which are applicable. Record the context and content of the dependency in sufficient detail so that later you will be able to identify the purpose or purposes of the dependency.

- f. The individual actions of the initiator before the dependency was initiated. Describe what the initiator was doing immediately before the dependency. You do not have to be extremely detailed. Typically, a single phrase will suffice (e.g., providing security, measuring the physical dimensions of a bridge abutment, etc.).
- g. The individual activities of the recipient(s) before participating in the dependency. Again, a single phrase should be sufficient. If there was more than one recipient and each was involved in a separate activity, then record the actions of each recipient if at all possible. If the recipients were all engaged in the same activity, then you need only record the activity once.

It might also help to realize that a mission can be divided into three segments. Identifying these segments, as well as remembering what is likely to happen in each segment can help to reduce observation to a manageable process. The three phases are:

1. Preparation. During the preparatory phase, you should look for the issuance of warning orders, operation orders, frag orders, etc. You should also look for the dependencies involved in preparing equipment and materials (e.g., loading vehicles, checking equipment, etc.). Most preparation phases also involve external dependencies.
2. Execution. This is the "meat" of the mission. During the execution phase, you should expect to observe nested teams being formed, team members within nested teams working together, nested teams working together, etc. Execution phases vary widely with the team type and the mission, thus more guidance cannot be provided.
3. Disposition or Termination Phase. When the main part of the mission is over, typically, most team types engage in some sort of cleanup activities. You should expect to observe the loading of equipment and materials, the disbanding of nested teams, status checks on equipment and material, etc. You should also expect some external dependencies involving the team leader. Typically, the team leader will inform his superior that the mission has been completed.

Treat each of the three segments as a separate observation unit with an identifiable beginning and end.

Observation Note Cautions

The description method described in this document is still in its infancy. Thus, not all the problems associated with the description method have been resolved. Most of these unresolved issues impact upon the observation phase, and the recording of the observation data on the required forms (Step 4). A discussion of these unresolved issues follows:

1. In practice, during observation of a mission, more than one mission might be observed. Recently, a mission performed by Combat Engineer squad was observed. The mission observed was labeled "preparation of a target folder." In reality, the major part of the mission was a bridge recon. During the recon, data were gathered for entry into the target folder. Preparing the target folder itself turned out to be a small part of the mission, and, incidentally, turned out to be an individual activity. The mission was observed from the moment the frag order was issued to the team members to the time the target folder was completed by the squad leader.

After the frag order was issued, the team engaged in some preparatory activities. When it was time to depart in the APC, the first set of activities involved moving the vehicle from its camouflage netting. This involved a certain amount of teamwork, and observers recorded the events.

When observers returned to complete the mission description forms, a debate started--was the removal of the vehicle from the netting really part of the mission or was it really a separate mission, according to the ARTEP manual? A search of the ARTEP manual revealed a Major Mission Operation title, "Conduct Unit Movement Operations." The removal of the vehicle from camouflage netting was not specifically called out within the list of missions, but could conceivably be a task within this Major Mission Operation. It was decided by observers that this activity was a separate mission and this segment of the mission was not recorded.

The authors cannot suggest a way to easily determine that what is observed is part of the mission you set out to observe. Only familiarity with the total population of missions performed by the team type would help. The best practice in this case is to record the events as part of the mission, then check the ARTEP manual or discuss the matter with an SME upon your return from the observation.

2. In practice you may see a repeat of the mission. For example, in the bridge recon discussed above, two bridges were assessed as part of the same mission. This should not bother you, since it provides an opportunity to verify observations. It is suggested that if this occurs during observation, that you treat the events as a single mission.
3. It has not been decided if it is important to collect other information. For example, the following information may be important:
 - a. Duration of the mission (start time, ending time).
 - b. Number of times the mission has been performed by the team observed.
 - c. The number of months or weeks the team has been together.
 - d. The amount of turnover in the team.

- e. Whether team members have been assigned unfamiliar, or novel, responsibilities.

At this time, there are no forms on which to record this information, but as an observer you should be sensitive to these issues and record these kinds of information if observed. It is expected that during the second and third years of the effort, the importance of collecting this kind of information will be further evaluated.

4. Although the description method is designed to record what you observe, there are certain practical limitations. If you observe two team members communicating with each other, and you hear them discussing content not related to the mission, should you take observation notes? A rather uncomplicated response is, "No." However, the difficulty arises in deciding what is mission related and what is not. Obviously, if the team members are discussing private matters, then the conversation is not mission related. However, interspersed within this private conversation may be examples of teamwork. For example, one member says, "Hey, we better hurry up." At first this warning may be taken casually by the observer, yet this dependency may be critical to mission success. There are no specific guidelines to help you determine what is and is not mission related. Record in the observation notes anything which you believe is mission related with the hope that non-mission related communications can be screened later. Your judgment on this issue should prevail.
5. During many of the observations, it has been noted that dependencies are often supplemented; e.g., an initiator would give a hand signal along with verbal instructions. This may appear, at first, to cause problems for the observer. Should the observer record the instances as a hand signal dependency or a verbal dependency? To be on the safe side, indicate that both verbal and hand signals were given for this dependency.

This phenomenon appears to happen primarily with communicative dependencies (i.e., product and procedural dependencies would not happen together, but communicative dependencies may supplement the passing of a product or completing a procedure). You should also be cautioned that it is easy to miss a product dependency or a procedural dependency when it is supplemented with a verbal command. Inexperienced observers often pick up the verbal communication (because it is usually obvious), and miss the transfer of a procedure or a product. It is easy to do. Thus, it is

suggested that for each verbal dependency you observe ask yourself--Is there anything else going on beside the transfer of words? In the second and third years of the current effort, more specific guidelines for this situation will be developed.

6. The last unresolved issue pertains to identifying dependency recipients. Often, when instructions or information are given by an initiator to a defined set of individuals, others can hear those instructions. The question is, "Should these 'other' individuals be listed as recipients in your observation notes?" Practice has been not to identify these "others" as recipients. It has been assumed that unintended recipients do not require the information to perform their assignments. Thus, they do not qualify as being part of the dependency. However, it is supposed that an unintentional recipient might eventually use the information. If the unintentional recipient uses the information in some way, then the recipient has indeed participated in the dependency. There are no guidelines to help you identify those situations where an unintentional recipient can be expected to become a legitimate recipient. Again, your own judgment should be used in this situation.

Every problem you might encounter has not been discussed. If you encounter a unique problem, it is suggested that you consult the team performance/behavior model for definitions and guidelines. By its definitions, the model will assist you in thinking about a problem. If the model does not assist you, then the recommendation is to describe exactly what you observe.

Forms

After the observation is over, you should complete the forms associated with Step 4, using information from the following sources:

1. The observation notes (including the notes gathered during the interview with the team leader).
2. The documentation notes (gathered when reading the documentation).

It is strongly suggested that you review your notes before completing the forms. If at all possible, the notes should be reviewed no later than 24 hours after the observation. This is to minimize any forgetting. In addition, the forms should be prepared as soon as possible after observation.

The five forms associated with this step can be completed in any sequence. However, for clarity, they are discussed in the sequence in which they were developed.

Before starting the forms, you may elect to meet with your observation team and make individual assignments for completing the forms. The discussion below assumes only one person will be completing each form. Examination of the sample forms in Appendix B while reading the following may prove useful.

General Mission Information (Form 3)

To provide an orientation to the mission that is being described, Form 3 was developed. The reader of your description might find it useful to examine Form 3 before any of the other mission specific forms, since it conveys the goal or purpose of the mission. The instructions for completing Form 3 are as follows:

1. Complete Blocks 1 through 6. These blocks are for recordkeeping purposes, and will help you keep track of all the forms that have been completed for the team type and the specific missions being described.
2. Enter in Block 7 a statement indicating the goal of the mission. When you interviewed the team leader, one of the questions asked was, "What is the purpose or goal of the mission?" Thus, your interview notes should be useful.

You should also consult the ARTEP manual. Typically for every Major Mission Operation, there is a brief description of the missions. The missions are described on a series of dimensions. Each dimension is given a specific title or heading. Under the title "General Standards" of the description, information about the goal of the missions within the Major Mission Operation is given. This should be read before completing Block 7.

3. Enter in Block 8 the criteria (or standards) for mission success. The ARTEP standard should be entered.
4. Enter in Block 9 any known conditions which influenced the performance of the mission, particularly those associated with climate, temperature, etc. You may also want to specify the enemy situation (e.g., was the enemy in the area; did the team expect any attack?). If NBC gear was used, its use should be entered in this block. The purpose of this block is to enter any information which might help the reader to understand the mission, as well as interpret

GENERAL MISSION INFORMATION

FORM 3

1. TEAM TYPE:	3. SOURCE(S)	5. PAGE ____ OF ____
2. MISSION TITLE:	4. PREPARER	6. DATE: ____/____/____

7. BRIEFLY DESCRIBE THE GOAL OF THE MISSION

8. SPECIFY THE CRITERIA OR MEASURE OF SUCCESS

9. SPECIFY KNOWN CONDITIONS (E.G., ENVIRONMENT FACTOR, ENEMY SITUATIONS)

10. SPECIFY NONORGANIC SUPPORT REQUIRED USED

11. SPECIFY ANY ASSUMPTIONS

12. ADDITIONAL NOTES OR COMMENTS (E.G., SPECIFY KNOWN EQUIPMENT DEFICIENCIES)

the specified criteria for completing the mission. Your observation notes will be helpful here.

5. Enter in Block 10 the non-organic support the team required to complete the mission, such as indirect fire support, security provided by another unit, etc. Frequently vehicles and equipment are obtained from other units. Be sure to specify all non-organic support noted during the observation. You may also want to check the ARTEP manual frequently. It describes the kind of support the team might require to execute the mission.
6. Enter in Block 11 any assumptions you may have made during the observation (e.g., it is assumed that "X" or "Y" is part of another mission, and although observed, is not described).
7. Enter in Block 12 any other information which you believe the reader might find important (e.g., equipment deficiencies, the experience or inexperience of the team leader, the reason why the ARTEP standard was/was not achieved, etc.).

Mission Situational Map (Form 3A)

In order to orient the reader to the mission, a situational map is constructed. In addition, the map also helps to explain or describe the observed team behaviors. Form 3A is designed to provide this sort of pictorial representation of the mission. The instructions for completing Form 3A are as follows:

1. Complete Blocks 1 through 6. Enter the same information (with the exception of Block 3) as entered in Form 3. Enter in Block 3, the sources used to develop the situational map. In most cases, this will be the observation itself.
2. In Block 7, construct a sketch of the mission as it was observed. The sketch should:
 - a. Use standard military symbols.
 - b. Illustrate troop movement (with directional arrows).
 - c. Indicate the location of trees, roads, bridges, brush, and other landmarks or features.
 - d. Indicate the position of the team members and/or nested teams in relationship to other team members,

MISSION SITUATIONAL MAP

FORM 3-4

1. TEAM TYPE	3. SOURCE(S)	5. PAGE ____ OF ____
2. MISSION TITLE	4. PREPARER	6. DATE: ____ / ____ / ____

<p>7. MISSION SITUATIONAL MAP. INDICATE ROADS, BRIDGES, TREES, POSITION OF TEAM MEMBERS, MOVEMENT OF TEAM MEMBERS, DISTANCES BETWEEN OBJECTS AND PERSONNEL, LOCATION OF VEHICLES, LOCATION AND OR DIRECTION OF ENEMY, ETC.</p>
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- nested teams, vehicles, and landmarks (e.g., buildings, trees, etc.).
- e. Label the approximate distance between team members, nested teams, etc. (Note: Only those distances critical to the mission should be given).
 - f. Indicate elevation if elevation is critical to the mission.
 - g. Show the location and movement of the OPFOR in relationship to the team being described.
 - h. Illustrate the location and movement of vehicles.
 - i. If movement of troops (including OPFOR) is indicated, attempt to associate the movement with a mission activity (i.e., when during the mission did the movement occur, such as before or after activity "X" or "Y").

It may be necessary to draw or construct more than one sketch, particularly if the mission is lengthy or if there is considerable movement of troops and vehicles. If multiple sketches are required to describe the mission, be sure to label each sketch (i.e., indicate what the sketch describes).

The situational map entered in Block 7 need not be precise and accurate. The purpose of the map is only to provide the reader with an orientation to the mission, as well as to explain possible team behaviors (e.g., movement of nested teams).

Users of the description method have also found it convenient to use Form 3A to describe specific items (e.g., when describing some of the missions performed by Combat Engineers, the users found it convenient to enter sketches of obstacles constructed in Block 7). These sketches were a supplement to the situational map. The item sketches should contain dimensions of the object, as well as pictorially represent the configuration of the item.

The primary source for the situational map should be your observation notes. If other sketches are provided; e.g., a detailed sketch of log crib or a minefield, you may find it necessary to consult field manuals. It is not necessary to duplicate any sketches provided in field manuals, simply reference the page and title of the field manual where the sketch can be located. If possible, attach a copy of the sketch to Form 3A.

Actual Team Structure (Form 4)

It is necessary to document the structure of the observed team. Of particular importance are the position titles of the team members, the number of soldiers having each position title, the equipment used by the position title, and the functions performed by the position title within the mission being described. It should be recalled that Form 2 was designed to record similar information for the nominal team structure. By comparing Form 2 with Form 4, the reader can determine if the actual team is under- or overstrength and has the necessary equipment.

The instructions for completing Form 4 are as follows:

1. Complete Blocks 1 through 6 in the usual manner. Be sure the information entered is identical to the information entered in Form 3 and Form 3A. In Block 3 enter the sources you used to complete the form. The primary source will be your observation notes.
2. In Block 7 enter the position titles that existed in the team. Enter the five digit MOS code and grade beside the position title. If you are not sure of either the position title or the MOS code, leave them blank, but be sure to complete Blocks 8 through 10 for the unknown position titles. It may be necessary to consult Form 2 when completing Form 4. Form 2 should contain the official position titles.
3. In Block 8 enter the number of individuals holding the corresponding position title. This may be difficult to do from the observation data. However, from the observation/interview data, you should have the total number of individuals in the actual team. What you may not have, if the actual team is extremely large, is the way the total number of team members are distributed among the position titles. If you do not know the number of individuals holding each position title, indicate "unknown."

Be sure that the box at the bottom of Block 8 contains the total number of team members of the actual team observed.

4. In Block 9 enter the equipment and materials you observed the position title using. If two or more team members have the same position title, but are using different equipment, separate the position titles with identifiers. For example, suppose the team observed has two construction specialists who use different equipment during the mission. The position titles should then be construction specialist (1) and construction specialist (2). Record in Block 9 the equipment used by each identified title (e.g., construction specialist (1)).

ACTUAL TEAM STRUCTURE

FORM 4

1. TEAM TYPE	3. SOURCE(S)	5. PAGE ____ OF ____
2. MISSION TITLE	4. PREPARER	6. DATE ____/____/____

7. POSITION TITLE & MOS CODE	8. NUMBER	9. EQUIPMENT ASSIGNED OR USED	10. MISSION FUNCTION PERFORMED INDICATE IF MEMBER OF NESTED TEAM

Enter only the equipment observed being used to perform the mission. You need not enter individual issue items unless the item is a weapon. If a tool used by the position title is part of a larger collection of tools, then specify the tool and the collection it is a member of (e.g., hammer [from carpenter's tool box]). Only the end user of the items should be entered (if not all the items in the carpenter's tool box were used do not enter the carpenter's tool box as a piece of equipment).

If position titles share a tool or piece of equipment, list the item for both position titles, but indicate in parenthesis that it is "shared" (e.g., hammer [shared between construction specialists]). Notice that if equipment is shared, then there is an opportunity for product or procedural dependencies to occur involving the equipment.

Specifying equipment is relatively important to training. Often, individual training and team training revolve around manipulating equipment and tools. Although it is often difficult, you should try to use the name of the tool as given in field manuals.

5. Enter in Block 10 the functions performed by the position title during the mission. The phrases entered should be short, but illustrative (e.g., provides security, carries mines to minefield, measures bridge structures with squad leader, etc.). If the position title is a member of a nested team, this should be indicated in Block 10 by either grouping positions within nested teams or indicating nested team membership with letters. Also enter the function of the position title within the nested team. Do not enter the function of the entire nested team, only the function performed by the individual within the nested team. There is a separate form for recording the major functions of each nested team. Be sure to be aware of the possible existence of variable nested teams.

If a team member performs multiple functions, be sure to enter each function. If a team member is a member of various nested teams, list all nested team affiliations in Block 10.

A typical entry can be fairly complicated (e.g., "loads vehicles with other team members; at the site performs the initial mine sweep; after mine sweep, joins security nested team and assumes security position northeast of the bridge; at bivouac site, helps other team members to offload vehicle").

Block 10 will typically contain information that is related to teamwork. In fact, Block 10 should highlight the teamwork the position title engages in during the mission.

Block 10 should provide the reader of your description with a summary of the individual and team activities of the position title (the model calls this a "role description").

Actual Team Structure - Nested Team Structure (Form 4A)

If the actual team observed had a nested team structure, then it is important to describe the nested team structure. Form 4A is designed to record nested team information (e.g., the number of nested team members, the title of the nested team, the functions performed by the nested team, and information concerning when and how the nested teams were formed and disbanded). If the actual team you observed did not have a nested team structure, then Form 4A need not be completed.

Before preparing Form 4A, your observation notes and documentation worksheet should be carefully reviewed. If the actual team had nested teams which were stable throughout the mission, then Form 4A will not be particularly difficult to complete. However, if the nested team structure was variable, Form 4A can be time consuming to complete. Notice that Block 10 of Form 4 must be consistent with what is entered in Form 4A; i.e., Form 4A indicates the nested teams, Form 4 indicates what position titles are members of each nested team, as well as what function each position served within the nested team. If nested teams were variable, then some position titles had changed from one nested team to another. Between Forms 4 and 4A, these changes should be clearly depicted.

If you believe you have observed variable nested teams, then it is suggested you do some pre-planning before completing Form 4A. The following activities should be performed:

1. On a standard sheet of paper, near the left edge, list all of the nested teams you observed. To label the nested teams, use words found in the documentation, or if the documentation does not label the nested teams, construct your own labels (e.g., security). Use labels which are descriptive of the function performed by the nested team.
2. At the top of the page, list each member of the larger team. Use short descriptive labels.
3. For each nested team, place an "X" in the cell of each individual whom you believe was a member of that nested team.
4. By looking down the column of each team member, you will be able to determine what nested teams the team member is associated with. If a team member is a member of more than one nested team, then a variable nested team structure is

ACTUAL TEAM STRUCTURE
NESTED TEAM DESCRIPTION

1. TEAM TYPE	3. SOURCE(S)	5. PAGE ____ OF ____
2. MISSION TITLE	4. PREPARER	6. DATE: ____/____/____

7. NESTED TEAM NAME	8. NUMBER OF MEMBERS	9. FUNCTION & MISSION PHASE	10. DESCRIPTION OF FORMATION

evident and one of several situations can exist. Either nested teams are formed and disbanded (allowing the nested team member to become a member of a new nested team or a member of an existing nested team), or an individual is a member of two or more nested teams simultaneously. The latter has never been observed, except where a team member is a supervisor and has management responsibilities for several nested teams. In these cases, the supervisor is not included as a member of any of the nested teams he supervises. Thus, if the team member is a member of more than one nested team, you must determine how that occurs. One simple explanation is that he is a member of nested teams which do not perform activities simultaneously. You should check your observation notes to determine if the two or more nested teams perform within the same period of time. If they do, then several explanations are possible. These are:

- a. The team member was reassigned to another nested team sometime during the mission. This should indicate some sort of dependency.
- b. The team member volunteered himself in and out of nested teams.

In either case, the sizes of the various nested teams may change during the mission, and this is important to note. Instructions for recording this variability are provided below.

5. Continue the analysis of the matrix you constructed until you have a complete picture of the size of each nested team, how the nested teams were formed and disbanded, when the nested teams were formed and/or disbanded, etc.
6. Attach the matrix to Form 4A, then complete Form 4A.

Before providing the instructions for completing Form 4A, some cautionary notes concerning variable nested team structure are warranted. During a recent observation, a situation arose which was almost impossible to record. The mission was the construction of a log crib by a platoon of over 30 team members. The team was not genuinely organized into nested teams. Nested teams were put together as needs arose (e.g., to dig post holes, to carry logs, to cut timber, to construct the log crib, etc.). Nested teams were put together almost at random--whoever was available and appeared to be unassigned was assigned to a nested team. Each nested team was temporary. For example, logs were carried from a dump point to the construction area several times. Each time the composition of the log carrying nested team was different. Because of the size of the team involved (a

platoon), it was impossible to keep track of every team member. Thus, it was impossible to accurately record who was a member of each temporary nested team. To record this situation, observers simply listed the various nested teams. They approximated the size of the nested team (with a minimum and maximum number). In addition, they recorded that the nested teams were formed upon demand and quickly disbanded when the immediate need was over. This was not a precise description of what occurred, but it did convey the general situation to the reader.

The instructions for completing Form 4A are as follows:

1. Complete Blocks 1 through 6 in the usual manner. Remember, in Block 3, you should enter the sources used to prepare the form. The primary sources will be documentation and your observation notes. Be sure to enter exactly the same information as entered in Forms 3, 3A, and 4.
2. In Block 7, enter the titles of each nested team. If the precise titles of the nested team are not known, enter a title which is descriptive of the nested team function.
3. In Block 8, enter the size of each nested team (how many team members composed the nested team). If the nested team varied in size, enter the smallest and largest size observed. Also, enter the average size of the nested team; the size the nested team tended to have for most of its existence. It is important to list the size as variable, because this is the only indication to the reader that the nested team structure was variable in size.
4. In Block 9, enter a description of the function performed by the nested team. Be as comprehensive and complete as possible. If the nested team performed multiple functions, be sure to list them all. You may also find it convenient to specify the phase of the mission in which the function was performed (e.g., "nested team performed function during preparation").
5. In Block 10, enter a description of how and when the nested team was formed and disbanded:
 - a. Indicate if the nested team structure was discussed during the frag order.
 - b. Indicate how individuals were assigned to nested teams (e.g., standing operating orders).
 - c. Indicate who was the supervisor of the nested team (by position title).
 - d. Indicate when the nested team was disbanded (e.g., when function is complete).

- e. Indicate how the nested team was disbanded (e.g., no orders given, the nested team disbands when the work assignment is complete, nested team leader informs next higher supervisor when the responsibility of the nested team has been satisfied).

Mission/Team Activity Description (Form 5)

The most useful mission data are detailed descriptions of the mission activities provided by Form 5. Form 5 is the most time consuming form to complete in the description process, since it contains a listing of mission activities, plus a description of the teamwork involved in those activities. The form is primarily designed to present the dependencies that occur in the mission, as well as the sequence of those dependencies. In addition, the form presents a description of each dependency; the dependency participants, dependency pattern, dependency type, dependency element, and dependency purposes.

Before completing Form 5, some preliminary activities are required:

1. Carefully review your documentation and observation notes. You must have a complete and accurate mental picture of the mission before you can record it on Form 5. It may be necessary to review your notes more than once.
2. If you have a nested team structure, determine whether you want to describe the activities of the team at large (the entire team) on Form 5, or use a separate Form 5 for each nested team. This is a critical decision. Experience indicates that if the actual team is small and has nested teams, it is more efficient to record the activities of the entire team (include the activities of each nested team on a series of Form 5s). If the team is larger or has three or more nested teams, it is more practical to record the activities of each nested team on a separate series of Form 5s. This decision has some recordkeeping and description consequences. If it is decided to describe each nested team on a separate Form 5, then an additional Form 5 will be needed to record the dependencies that occur between the nested teams. This additional Form 5 is not needed if all the nested teams are described on the same Form 5, since between nested team dependencies will be described on it, as well.
3. If it has been decided to describe each nested team on a separate series of Form 5s, then you have another decision to make. Should you describe the dependencies between the

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nested teams first, or describe the within-nested-team activities first? Experienced describers find no advantage one way or the other.

4. Depending upon what approach you have selected, perform the following:

- a. If you have elected to describe the entire team on one Form 5, review your notes and documentation. Then, on a worksheet, record or list the team mission activities in the sequence in which they occurred. To help you organize the list of activities, keep in mind the concept of mission phases. The activities should not be described in detail, use brief phrases (e.g., issue frag order, prepare equipment, load vehicle, mount vehicle, enroute activities, initial on site activities and orders, establish security, etc.). Use phrases which indicate team activities and/or dependencies. Be sure the activities are in their proper sequence. If some mission activities are repeated, note this.
- b. If you have elected to describe the activities which occurred within each nested team separately, then prepare a worksheet for each nested team. This worksheet should be similar to the worksheet described in item a above.
- c. If you have elected to describe the dependencies between the various nested teams first, then construct a matrix of nested teams titles. In the cells of the matrix indicate which nested teams have dependencies with other nested teams. Briefly describe the between-nested-team dependencies. Use key words or phrases. This is similar to the matrix developed in the documentation worksheet.

After completing these preliminary activities, you are ready to start completing Form 5s. The instructions for completing Form 5s are provided below. These instructions are appropriate regardless of what approach you have selected.

1. Complete the first six blocks of each Form 5 in the usual manner. Be sure all the entries are identical to previously completed forms.
2. If the team has a nested team structure, circle "Y" in Block 7; otherwise, circle "N." If the "Y" is circled, then a Form 4A should be completed.

3. In Block 8, check the most appropriate phrase. This block is designed to communicate your decision concerning which approach you have elected (to describe the activities of each nested team on a separate Form 5 or describe the activities of the larger team on one Form 5). If you are describing the dependencies between nested teams, leave Block 8 blank.
4. If you checked the first phrase in Block 8, then in Block 9 enter the name of the nested team being described.
5. Review your preliminary worksheet notes (the ones developed before starting to complete Form 5). Enter the first team or mission activity on your list (e.g., platoon leader issues operation order to squad leader) in Block 10, toward the top. The phrase should be more descriptive than the phrase in your worksheet notes. The phrase should have a subject ("platoon leader"), a verb ("issues"), and an object of the verb ("operation order"). For clarity, you should also enter any informative phrases (e.g., "to the squad leader"). Remember, the phrase must provide the reader with an understanding of what is going on in the mission. Enter successive mission events or activities in order down Block 10, using additional Form 5s as required.
6. In Block 11, enter a label at the top of each column indicating each of the team or nested team members. If the form is being used to describe the dependencies between nested teams, enter a label indicating the nested team name. For convenience, each label should be numbered. If there is insufficient space to record the team member's title or the nested team name, record the titles or names on a separate sheet of paper. Number them from one to the size of the team or to the total number of nested teams. Enter in Block 11 only the corresponding numbers. Attach the separate sheet to the front of the first page of Form 5.

Block 11 only contains enough space for an 11 member team or nested team. If the team or nested team you are describing has more than 11 members, then you must construct an additional parallel series of Form 5s.

Enter, in the columns of Block 11, the participants of the first activity recorded in Block 10. Identify the initiators by entering an "I" in the appropriate columns. Identify the recipient(s) by entering an "R" in the appropriate column(s). A single individual can be both an initiator and recipient in a given dependency. If this is

the case, enter in the appropriate columns "I/R." It should be noted that in external dependencies only an "I" or "R" will be entered, but not both.

7. In Block 12 enter the information necessary to describe the dependency. Perform the following activities:

- a. Determine if the dependency is external or internal. External dependencies can be easily identified. In external dependencies, the initiator or recipient is an individual outside the team of interest. Thus, in Block 11, the columns would contain only an "R" or "I," but not both. If the activity being described involves an external dependency, place an "E" in Block 12.
- b. Determine the dependency pattern (the flow of the dependency element from the initiator[s] to the recipient[s]). In discussing the model, several common patterns were noted and defined. Standard sketches of these patterns were developed. Examine the dependency under consideration and attempt to match it with one of the common patterns.

These common patterns and their definitions and sketches are illustrated in the section dealing with the model. To match a pattern, simply determine the number of initiators, the number of recipients, and how the dependency element flows from the initiators to the recipient(s).

If you cannot match the observed pattern with a standard pattern, then you must sketch the pattern (i.e., a standard sketch cannot be used). To sketch the observed pattern, simply start from the initiator and draw lines with arrowheads indicating the direction the dependency element flowed to the recipients. It has been our experience that non-standard patterns are very rarely needed.

In Block 12, enter the sketch of the pattern. For example, if the observed pattern is a fanout pattern (one initiator, several recipients, several very similar dependency elements), then in Block 12 enter the following sketch:

—————<<

- c. At the top left of the sketch, enter the initiator of the dependency as a number. Use the number of the team member indicated in Block 11 (i.e., the number corresponding to the column which contains an "I").

Also, indicate the recipients on the top right of the sketch by entering the numbers of the columns in Block 11 corresponding to those who are identified as recipients.

Thus, if position 1 was the initiator and positions 3, 4, and 5 were the recipients in a fanout dependency, the appropriate sketch would be:

1 3, 4, & 5 <<

- d. Determine if the dependency followed a "Z" format. A "Z" format occurs if the recipients ask questions of the initiator. For example, when a frag order is issued by a squad leader, the team members might ask specific questions. Although the pattern is basically a fanout pattern, the question and answer part of the dependency makes the fanout a "Z" format. Almost any standard pattern can have "Z" format.

To indicate a "Z" pattern, enter the letter "Z" after the initiator. Thus, in the example, we have been using a fanout "Z" pattern would be indicated as:

1 | Z | 3, 4, & 5 <<

- e. Determine if the recipients received the dependency elements individually or as a group. This is particularly important in fanout patterns. For example, a frag order can be issued by the squad leader to all the team members at one time, or the frag order can be issued to each individual separately, but approximately within the same time period. In either case, the appropriate pattern is a fanout pattern. However, it is important to specify if the recipients received the information individually or as a group. To specify if the fanout was group-oriented or individually-oriented, record the words "group" or "individual" at the

bottom middle of the sketch. For example, a fanout pattern, where the recipients receive the dependency element in a group, would be recorded as:

1 | Z | 3, 4, & 5
Group <<

An alternative is to bracket those who received the dependency element as a group; e.g.,

1 | Z | [3, 4, & 5] <<

If the recipients received the information individually, the situation would be represented as:

1 | Z | 3, 4, & 5 <<

There are occasions where some individuals receive the dependency element as a group, while others receive it individually. For example, in the illustration being used, if the team members 3 and 4 received the content of the frag order as a group from team member 1, while team member 5 received it individually, then this situation would be represented as:

1 | Z | [3, 4] & 5 <<

or it could be represented as two separate patterns:

1 | Z | 3, 4] <<

1 —————> 5

The first pattern is a "Z" fanout with two recipients. The second pattern is a simple pattern with one initiator and one recipient. Two patterns should be used to represent the situation only if the patterns are different; e.g., in the example given above, the group situation involved a question and answer component; thus, a "Z" format is not indicated. In the second pattern, there was no question and answer period. Thus, a "Z" format is not indicated. These patterns are different, and therefore, two separate patterns can be used.

- f. Determine the dependency type. The section dealing with the model of team performance and behavior discusses dependency types.

Select a dependency type which you believe correctly represents the mission activity being described. For the type selected, record the type abbreviation in the appendix. If the situation involved is consistent with the definition, then the correct type has been selected. If the definition does not agree with your specific situation, then repeat the process until a suitable type is found.

Once you have selected the most appropriate dependency type to describe the situation or activity, it must be recorded in Block 12. Each dependency type has a code. The code of the selected type is entered at the top right of the sketch (above the recipient identifiers). In the frag order illustration, the content of the frag order was given verbally to the recipients (the communication was not mediated or given indirectly via a radio). Thus, the proper type is direct verbal communication (or verbal communication, direct). The proper code is "CD." The code would be recorded in the following manner:

CD

1 | 2 | [3, 4, & 5] <<

In a previous section it was noted that some dependency types are supplemented or paralleled with another dependency type. For example, a hand signal for an Infantry fire team to flank right or left is often supplemented with a verbal command; i.e., the oral command is given at the same time the hand signal is given. A review of the dependency type definitions would reveal that two types of dependencies are appropriate to describe the situation (direct verbal communication and standard hand signals). The codes for these are CD and CN, respectively. Thus, the situation could be recorded as follows:

CD, CN

1 | [2, 3, 4, 5, 6] <<

Notice that both dependency types are recorded, separated by a comma. Multiple codes will typically only be required if one of the dependency types is a verbal communication; i.e., verbal communications are given when hand signal are given; when products are transferred, etc.).

g. Determine the dependency element. The dependency element refers to the communication, the product, procedure, or service that was transferred during the dependency. Notice that dependency elements correspond closely to dependency types. For example, in a product dependency, the dependency element is a product. In a communicative dependency, the dependency element is a message. In a procedural dependency, the dependency element is the completion of a set of activities. In virtual dependencies, the dependency element is a shared service (such as security). Thus, examine the identified dependency type. If it is:

- A communicative dependency, specify the content of the message (e.g., if a frag order is given, specify the content of the order; if a hand signal is given indicate what the hand signal means).
- A product dependency, specify or describe the product (e.g., a charged and fused mortar round). Be sure to specify any important characteristics of the product.
- A procedural dependency, specify or describe the set of activities that are completed (e.g., a sited minefield, a completed operational check, etc.).
- A virtual dependency, specify or describe the service or shared activity (e.g., security being provided).

Record the dependency element below the sketch of the dependency pattern. In the frag order example, the dependency element would be recorded as follows:

CD

1 | 2 | [3, 4, & 5] <<

ELEMENT: FRAG ORDER CONTAINED THE FOLLOWING INFORMATION--PURPOSE OF THE MISSION, TIME OF DEPARTURE, CHAIN OF COMMAND, PASSWORDS, FRIENDLY SITUATION, ENEMY SITUATION, WHAT TO DO UPON ENEMY ATTACK, INDIVIDUAL ASSIGNMENTS, REVIEW OF STANDING OPERATING PROCEDURES AND SIGNALS, MISSION APPROACH, LENGTH OF MISSION, EQUIPMENT STATUS, CONDITIONS OF PERSONNEL, STATUS OF AMMO.

- h. Determine the purpose of the dependency. The section containing the model provides a list of dependency purposes and definitions. To determine the purpose of a dependency, the context of the dependency must be understood (i.e., you must understand why a frag order is given; why a hand signal is given; why a product is transferred, etc.). Thus, to determine the dependency purpose ask yourself:

"What is the purpose of the dependency or teamwork?"

Often the question can be answered by reading the description of the dependency element. After asking yourself the above question, examine the list of dependency purposes. Read each purpose and ask yourself if this purpose is appropriate for the dependency being described. Record, in Block 12, each purpose that is deemed appropriate. Record the identified or selected purposes at the bottom right hand side of the sketch. To continue the frag order example, it can be determined that the frag order has many purposes. These are:

- . Orders, instructions, and directions (e.g., time of departure, chain of command).
- . Status of Individual Activities (e.g., making of assignments).
- . Status of Personnel (e.g., who is injured).
- . Status of Supplies (e.g., number of ammo rounds).
- . Status of Equipment (e.g., working condition of M-16).
- . Information--Mission Environment (e.g., location of friendly troops).
- . Information--OPFOR (e.g., enemy location).

The codes for each of these are: OID, SIA, SP, SS, SE, INE, and IMO, respectively. The purposes would be recorded as follows:

CD

1 | 2 | [3, 4, & 5] <<
OID, SIA, SP, SS, SE, INE, IMO

Few dependencies have as many purposes as a frag order. Typically, only one or two purposes are enough to adequately describe the situation.

It should be noted that dependency purpose categories are scheduled to be revised during the second year of the effort.

Completing Block 12 of Form 5 is the most difficult activity in completing Form 5. There is a lot of information which must be entered. A summary of the substeps involved in completing Block 12 is provided in Table 4. This table can be used as a job aid when preparing Block 12.

8. In Block 13 enter any information which might be helpful to the reader of the description in understanding the activity or dependency. For example, if a hand signal is used you may want to describe the hand signal (such as, hand signal was flat hand, palm out, held near the chest). You may also want to describe the individual activities of the initiator and recipient(s) before and after the activity or dependency if this is not clear from the description itself.
9. Repeat steps 1 through 8 for the next team or mission activity on your worksheet list. Continue this process until all activities are described.

Helpful Hints for Completing Form 5

Experience in completing Form 5 has resulted in some useful conventions which you might want to adopt. These are:

1. Although only a selected variety of team types have been observed to date, it has been noticed that some mission activities are common to many missions. For example, most missions involve the issuance of orders. The lifting and carrying of objects recurs, as does loading and unloading materials and supplies. Because of the commonality of mission activities, the authors have prepared descriptions of these common activities. The descriptions discuss the common mission activities and provide guidance about how to record these in Block 12. For convenience, these descriptions are provided in Appendix C.

When you record a mission activity in Block 10 of Form 5, it is suggested that you consult Appendix C. Determine if the mission activity you are about to describe is discussed in the Appendix. If it is, then much of the work involved in completing Block 12 can be minimized.

Table 5

Summary of Instructions for Completing Block 12

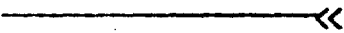

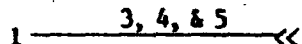
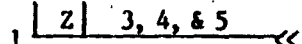
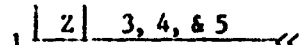
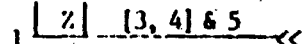
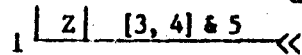
Step	Status of Block 12
1. Determine if mission activity involves an external dependency or an internal dependency.	If external dependency, enter an "E" in Block 12. If internal dependency, enter nothing.
2. Determine the dependency pattern (see model for standard patterns).	Enter sketch of dependency pattern; e.g., 
3. Identify initiator of dependency (examine Block 11 for an "I").	Enter initiator's number designation on sketch of dependency pattern; e.g., 
4. Identify recipients of dependency element (examine Block 11 for "Rs").	Enter recipient's number designation on sketch of dependency pattern; e.g., 
5. Determine if pattern has "Z" format.	If question and answers, then indicate a "Z" format; e.g., 
6. Determine if recipients received dependency element individually or as a group.	If received as group or individually, indicate so on pattern:  Group = 3, 4; Individual = 5 This can also be represented in a short-hand manner. Place brackets around those who received the dependency element as a group; e.g., the following sketch is considered equivalent to the above sketch: 
7. Determine dependency type (see model).	Enter appropriate type code; e.g., 

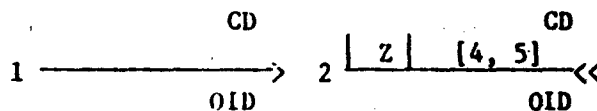
Table 5 (Continued)

Summary of Instructions for Completing Block 12

Step	Status of Block 12
<p>8. Describe dependency element (i.e., describe what is transferred from initiator to recipient(s).</p>	<p>Enter description of dependency element below sketch; e.g.,</p> <p style="text-align: right;">CD</p> <p>1 Z [3, 4] & 5 <<</p> <p style="text-align: center;">- ELEMENT -</p> <p>FRAG ORDER CONTAINED THE FOLLOWING INFORMATION—PURPOSE OF MISSION, TIME OF DEPARTURE, CHAIN OF COMMAND, PASSWORDS, FRIENDLY SITUATION, WHAT TO DO UPON ENEMY CONTACT, INDIVIDUAL ASSIGNMENTS, REVIEW OF STANDARD OPERATING PROCEDURES AND SIGNALS, MISSION APPROACH, TIME OR LENGTH OF MISSION, EQUIPMENT STATUS, CONDITION OF PERSONNEL, STATUS OF AMMO.</p>
<p>9. Determine dependency purpose(s) (see model).</p>	<p>Record dependency purpose(s); e.g.,</p> <p style="text-align: right;">CD</p> <p>1 Z [3, 4] & 5 <<</p> <p style="text-align: center;">OID, SIA, SP, SS, SE, IRE, IMD</p> <p style="text-align: center;">- ELEMENT -</p> <p>FRAG ORDER CONTAINED THE FOLLOWING INFORMATION—PURPOSE OF MISSION, TIME OF DEPARTURE, CHAIN OF COMMAND, PASSWORDS, FRIENDLY SITUATION, WHAT TO DO UPON ENEMY CONTACT, INDIVIDUAL ASSIGNMENTS, REVIEW OF STANDARD OPERATING PROCEDURES AND SIGNALS, MISSION APPROACH, TIME OR LENGTH OF MISSION, EQUIPMENT STATUS, CONDITION OF PERSONNEL, STATUS OF AMMO.</p>

It should be realized that Appendix C will not provide guidance on every situation you must describe. However, it does discuss those mission activities which are likely to be repeated in the mission and/or frequently encountered.

2. Experienced users of the description method have a tendency to attempt to "chain" dependency patterns together. For example, suppose team member 1 issues an order to team member 2, who in turn issues the order to team members 4 and 5. There is a tendency for experienced users to sketch the dependency in this fashion:



Although this is acceptable (because it can be interpreted), it is strongly suggested that first time users avoid chaining dependency patterns together until they have accumulated a fair amount of experience. It is not as easy as it looks, and often times you can unintentionally misrepresent what you have observed.

3. If a single member of the team is engaged in a given individual activity for a good part of the mission, it is reasonable to list this individual activity in Block 10 of Form 5, and then indicate that the activity continues by placing a line down the individual's column in Block 11. The line should continue until the individual changes activities.
4. Often segments or sections of a mission are repeated; e.g., the second row of a minefield is laid exactly like the first row. There appears to be no need to duplicate these in the mission description. It is useful to bracket those repeated activities and note that the bracketed activities are repeated "X" times.
5. It is often helpful to explain the situation you are trying to describe to another individual familiar with the description method. Often this person can assist you in determining how to exactly record the situation. This technique is particularly useful if you have encountered a situation that is giving you difficulty.

CONCLUDING REMARKS

Although the description method may at first appear to be overwhelming, it is not. Experience has shown that the first attempt can be frustrating. There is a lot of information to record, and there are a lot of recording guidelines to remember. It will be found that practice greatly improves the situation. This report has attempted to make the process as systematic as possible. However, every mission and team type is to some extent unique. This uniqueness makes it impossible to develop a process which is rigid or mechanical.

In addition, this report has attempted to alert the user to possible situations which might be encountered and to suggest possible recording solutions. This desire to avoid surprises for the user has resulted in a detailed complete discussion of the team description method. One concern is that the user will encounter a situation not covered or discussed in this document. Failure to adequately discuss possible deviations might lead the user to either disuse the description method or to become so creative in recording observed team activities that the resulting description would not be readable or interpretable by others. One objective of preparing this report was to avert either outcome.

Although this document contains definite procedures and recording conventions, it should not be forgotten that the purpose of the description method is to record information about team types and the missions they perform, which readers of the forms can understand and use. It is really not so important to adhere strictly to the guidelines or conventions provided herein. Indeed, the important criterion is to generate team and team mission descriptions which others can read, understand, and use. The guidelines and conventions were designed to assist you in identifying what is important to record about the team type and the missions it performs. The guidelines should not be viewed as laws. If you encounter a situation which dictates violating the conventions or guidelines in order to improve the clarity of the description, then you should feel free to do so.

A final note to the reader: this Description Method (and its doubtless more refined successors) is a tool, with specific projected applications. Foremost of the applications is the development of team training programs and techniques, and team performance and evaluation measures. Since the Description Method is to be widely applied in the future, it must be flexible and adaptable. The Description Method, again, is not law, it is a tool for your use, which can be modified or adapted to suit your specific needs.

APPENDIX A
DOCUMENTATION WORKSHEETS

DOCUMENTATION WORKSHEET

Team Type: _____ Preparer: _____

Mission Title: _____

Sources: _____

1. Do you suspect a nested team organization? ____ Yes ____ No. If Yes, list the nested team names and the number of team members in the nested team.

	<u>Name</u>	<u>Size</u>	<u>Stable</u>	<u>Variable</u>
1.	_____	_____	_____	_____
2.	_____	_____	_____	_____
3.	_____	_____	_____	_____
4.	_____	_____	_____	_____
5.	_____	_____	_____	_____
6.	_____	_____	_____	_____
7.	_____	_____	_____	_____

Also indicate if the nested team structure is stable throughout the mission or is variable.

2. If a nested team structure exists, then enter in the cells below the dependencies you expect between the nested teams which are unclear from the documentation.

	2	3	4	5	6	7
1						
2						
3						
4						
5						
6						

Additional Comments

- Below summarize the dependencies which you feel require careful observation.

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APPENDIX B

SAMPLE TEAM TYPE AND MISSION DESCRIPTIONS

TEAM MISSION LISTING

FORM 1

1. TEAMTYPE COMBAT ENGINEER SQUAD, RELAYED	2. PREPARER R.J. HEIFZ, APPLIED SCIENCE ASSOC. 912-586-7771	3. PAGE 1 OF 2
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4. MISSION TITLE	5. STATUS		6. SOURCE(S)	7. DATE IDENTIFIED	8. COMMENTS
	ADD	DEL			
CONSTRUCT OBSTACLE AND DEFENSIVE OPERATIONS					
6-14 REPAIR TARGET FOLDER	✓		SGT R. LOVE (FT BELVOIR)	8 DEC. 1981	PREVIOUSLY PERFORMED BY PLATOON, NOW ASSIGNED TO SQUADS
6-28 CONSTRUCT BOOBY TRAPS		✓	SGT. RICKS (FT BELVOIR)	8 DEC. 1981	REASON FOR DELETION UNSPECIFIED
PERFORM ADMINISTRATIVE AND LOGISTIC FUNCTIONS					
2-? PREPARE RANGE CARDS	✓		SGT CROXTON (FT BELVOIR)	8 DEC. 1981	REASON FOR ADDITION UNSPECIFIED; MISSION NUMBER NOT SPECIFIED
PERFORM COMMAND AND CONTROL FUNCTION					
2-7 CONDUCT TROOP LEADING PROCEDURES		✓	SGT. RICKS & SGT CROXTON (FT BELVOIR)	8 DEC. 1981	REASON UNSPECIFIED
CONDUCT BREACHING AND CLEARING OPERATIONS (MOBILITY)					
7-7 EMPLOY ARMORED VEHICLE LAUNCH BRIDGE (AVLB)		✓	SGT CROXTON	8 DEC. 1981	REASON UNSPECIFIED
CONT ON NEXT PAGE					

ARTEP 5-145, ENGINEER BATTALION MECHANIZED AND ARMOR DIVISIONS
 PAGES 2-11 TO 2-13, 15 JUNE 1978
 Attach ARTEP Mission Listing

TEAM MISSION LISTING

FORM 1

1. TEAM TYPE	COMBAT ENGINEER SQUADS, MECHANIZED	2. PREPARER	B.J. WHITE, APPLIED SCIENCE ASSOC. 412-546-7773	3. PAGE	2	OF	2
--------------	------------------------------------	-------------	--	---------	---	----	---

4. MISSION TITLE	5. STATUS		6. SOURCE(S)	7. DATE IDENTIFIED	8. COMMENTS
	ADD	DEL			
CONDUCT FLOAT BRIDGE OPERATIONS					
10-29 OPERATE MAB TRUCKS- PORTER ON LAND	✓		SAT RICKS + SAT CLAYTON (FT. BELVOIR)	8 DEC 1981	MAB NOT USED
10-30 CONDUCT AND OPERATE MAB RAFT	✓				
10-32 REPLACE DAMAGED MAB RAY	✓				
10-34 INTERCHANGE MAB SUPERSTRUCTURES	✓				
CONDUCT HORIZONTAL CONSTRUCTION OPERATIONS					
23-3 CLIENT AND GROUP SITE WITH HEAVY EQUIPMENT	✓		SAT RICKS (FT. BELVOIR)	8 DEC 1981	RICKS - UNDESIGNED

Attach ARTEP Mission Listing

SQUAD/SECTION TASK INVENTORY

UNIT TRAINING					TOE S-145 ENGR BN		TOE S-108 CAV RGT				TOE S-127 SEP BDE									
COLLECTIVE TRAINING BEGINS	UNIT ACHIEVES LEVEL 3	UNIT ACHIEVES LEVEL 2	UNIT ACHIEVES LEVEL 1		ENGR SOD	HVY RAFT SEC	CEV SEC	AVLB SEC	ENGR SOD	CEV SOD	AVLB SEC	MAINT SEC	CONST SEC		ENGR SOD	HVY RAFT SEC	CEV SEC	AVLB SEC	EQUIP & MAINT SEC	
<div><div>TRAINING LEVEL 3 TASKS</div><div>TRAINING LEVEL 2 TASKS</div><div>TRAINING LEVEL 1 TASKS</div><div>MIN TWO PROFICIENCY FOR COMBAT READY STATUS</div></div>																				
LOCATE YOUR UNIT IN THE LIST TO THE RIGHT OF THIS BLOCK. HIGHLIGHT ALL DOTS/XS THAT FALL IN THE COLUMNS BELOW YOUR UNIT. THESE HIGHLIGHTED DOTS/XS REPRESENT THE TASKS THAT ARE ASSIGNED TO YOUR UNIT. LEVEL X TASKS APPLY ONLY TO UNITS WITH THAT SPECIFIC CONTINGENCY MISSION.																				
1. PERFORM COMMAND AND CONTROL FUNCTION																				
1-7 Conduct troop leading procedures.					3	3	3	3	3	3	3	3	3		3	3	3	3	3	
1-21 Conduct radio communications.					3	3	3	3	3	3		3	3		3	3	3	3	3	
1-27 Operate in an electronic warfare environment.					3	3	3	3	3	3		3	3		3	3	3	3	3	
2. PERFORM ADMINISTRATIVE AND LOGISTIC FUNCTIONS																				
2-17 Supervise operator maintenance.					3	3	3	3	3	3	3	3	3		3	3	3	3	3	
4. CONDUCT SECURITY OPERATIONS																				
4-4 Camouflage position and equipment.					3	3	3	3	3	3	3	3	3		3	3	3	3	3	
4-7 Defend against NBC attacks.					3	3	3	3	3	3	3	3	3		3	3	3	3	3	
4-10 Defend against air attack						3										3				
4-11 Request and adjust fire.					1										1					
4-13 Secure worksite.					3			3							3					
4-14 Conduct reconnaissance patrol.					1			1							1					
4-17 React to enemy contact (Squad).					3			3							3					
4-19 Process prisoners of war (PWs).					1			1							1					
4-25 Conduct civil disturbance operations (Squad).					X			X							X					
4-32 Engage targets with 50 caliber machine gun.					3		3	3		3					3		3			
4-33 Engage armor targets with M72A LAW.					3			3							3					
5. PROVIDE INFORMATION AND INTELLIGENCE																				
5-9 Submit intelligence spot reports.					3	3	3	3	3	3	3	3	3		3	3	3	3	3	
5-12 Conduct reconnaissance for obstacle locations.					3			3							3					
5-13 Conduct special reconnaissance missions.					3			3							3					
5-15 Conduct a hasty route reconnaissance.					2	2	2	2	2	2	2	2	2		2	2	2	2	2	

SQUAD/SECTION TASK INVENTORY

UNIT TRAINING				TOE 5-145 ENGR BN		TOE 5-108 CAV RGT				TOE 5-127 SEP BDE								
COLLECTIVE TRAINING BEGINS	UNIT ACHIEVES LEVEL 3	UNIT ACHIEVES LEVEL 2	UNIT ACHIEVES LEVEL 1	MIN 70% PROFICIENCY FOR COMBAT READY STATUS														
TRAINING LEVEL 3 TASKS	TRAINING LEVEL 2 TASKS	TRAINING LEVEL 1 TASKS		ENGR SOD	HVY RAFT SEC	CEV SEC	AVLB SEC	ENGR SOD	DEV SOD	AVLB SEC	MAINT SEC	CONST SEC		ENGR SOD	HVY RAFT SEC	CEV SEC	AVLB SEC	EQUIP & MAINT SEC
5-19	Conduct a bridge reconnaissance.			3			3							3				
5-28	Reconnoiter assault bridge crossing sites.			2			2							2				
5-29	Conduct river reconnaissance.			2	2		2	2						2	2			
5-30	Reconnoiter crossing area.			2	2		2	2						2	2			
6. CONDUCT OBSTACLE AND DEFENSIVE OPERATIONS (COUNTERMOBILITY)																		
6-16	Disable bridges.			3			3							3				
6-17	Crater roads.			3			3							3				
6-18	Construct barbed-wire entanglements.			2			2							2				
6-21	Emplace non-explosive anti-vehicular obstacles.			3			3							3				
6-28	Construct booby traps.			1			1							1				
6-37	Install a point minefield.			3			3							3				
7. CONDUCT BREACHING AND CLEARING OPERATIONS (MOBILITY)																		
7-3	Breach obstacles with explosives.			3			3							3				
7-7	Employ the armored vehicle launched bridge (AVLB).						3		3								3	
7-8	Employ the combat engineer vehicle (CEV).					3			3							3		
7-9	Construct combat trails.			1	1	1	1	1						1	1			
7-11	Assist in the assault of fortified positions.			3	3	3	3	3	3	3				3	3	3		
8. CONDUCT FIXED BRIDGING OPERATIONS																		
8-5	Reinforce bridge with pier/bent.			1			1							1				
8-8	Layout Bailey bridge site.			1			1							1				
8-20	Reinforce damaged panel.			1			1							1				

SQUAD/SECTION TASK INVENTORY

UNIT TRAINING				TOE 5-145 ENGR BN		TOE 5-108 CAV RGT				TOE 5-127 SEP BDE								
COLLECTIVE TRAINING BEGINS	UNIT ACHIEVES LEVEL 3	UNIT ACHIEVES LEVEL 2	UNIT ACHIEVES LEVEL 1															
<div><div>TRAINING LEVEL 3 TASKS</div><div>TRAINING LEVEL 2 TASKS</div><div>TRAINING LEVEL 1 TASKS</div><div>MIN T110 PROFICIENCY FOR COMBAT READY STATUS</div></div>																		
LOCATE YOUR UNIT IN THE LIST TO THE RIGHT OF THIS BLOCK. HIGHLIGHT ALL DOTS/SX THAT FALL IN THE COLUMNS BELOW YOUR UNIT. THESE HIGHLIGHTED DOTS/SX REPRESENT THE TASKS THAT ARE ASSIGNED TO YOUR UNIT. LEVEL X TASKS APPLY ONLY TO UNITS WITH THAT SPECIFIC CONTINGENCY MISSION.				ENGR SOD	HVY RAFT SEC	CEV SEC	AVLB SEC	ENGR SOD	CEV SOD	AVLB SEC	MAINT SEC	CONST SEC		ENGR SOD	HVR RAFT SEC	CEV SEC	AVLB SEC	EQUIP & MAINT SEC
10. CONDUCT FLOAT BRIDGING OPERATIONS*																		
10-20 Install guylines.				2	2								2	2				
10-23 Construct a light tactical raft.				2	3								2	3				
10-29 Operate MAB transporter on land.					3									3				
10-30 Construct and operate MAB rafts.					3									3				
10-32 Replace damaged MAB bay.					3									3				
10-34 Interchange MAB superstructures.					2									2				
13. CONDUCT HORIZONTAL CONSTRUCTION OPERATIONS																		
13-3 Clear and grub site with heavy equipment.																	2	
14. CONDUCT VERTICAL CONSTRUCTION OPERATIONS																		
14-6 Construct a lifting device.				1			1						1					
17. CONDUCT FIELD WATER SUPPLY OPERATIONS																		
17-2 Reconnoiter potential water point				3			3						3					
*NOTE: If the Bridge Company/Platoon is equipped with M4T6 equipment, the unit will train only M4T6 related tasks. If the Bridge Company/Platoon is equipped with MAB, the unit will train only the MAB tasks.																		

NOMINAL TEAM STRUCTURE

FORM 2

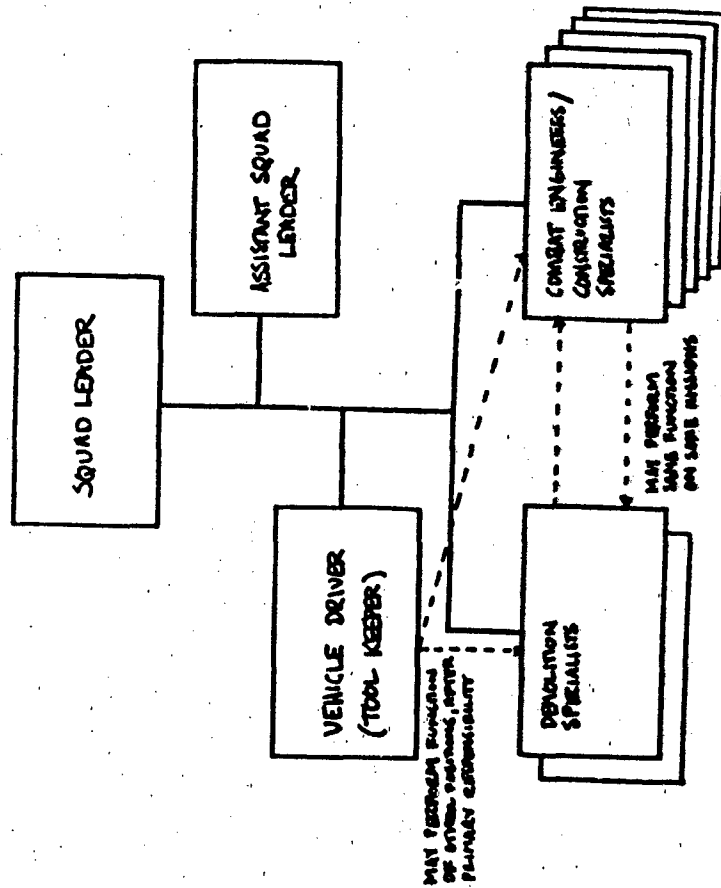
1. TEAM TYPE COMBAT ENGINEER SQUAD, MECHANIZED	3. PREPARER: NJMRTS, APPLIED SCIENCE ASSOC 412-586-7778	5. PAGE 1 OF 1
2. SOURCE(S) SHE ENGINEER AT PT BAYVIEW WITH 16th LOGS, CROTON, AND RICKS; ALSO S-145	4. DATE: 04 / 30 / 82	

6. POSITION TITLE & MOS CODE	7. NUMBER	8. EQUIPMENT ASSIGNED OR TYPICALLY USED BY TITLE
SQUAD LEADER 12830 (E-6)	1	BASIC ISSUE (INCLUDING NBC), LENSATIC COMPASS, NOTEBOOK, PENCIL, JOB BOOKS, DEMOLITION BOX
ASSISTANT SQUAD LEADER 12820 (E-5)	1	BASIC ISSUE (INCLUDING NBC), LENSATIC COMPASS, NOTEBOOK, PENCIL
VEHICLE DRIVER 12810 (E-4) (MAY ALSO BE TOOL KEEPER)	1	BASIC ISSUE (INCLUDING NBC), VEHICLE, TOOLS TO MAINTAIN VEHICLE
DEMOLITION SPECIALISTS 12820 OR 12820 (E-4 TO E-5)	2	BASIC ISSUE (INCLUDING NBC)
CONSTRUCTION SPECIALISTS / COMBAT ENGINEERS 12810 OR 12820 (E-3 TO E-4)	5	BASIC ISSUE (INCLUDING NBC), POWER TOOLS (LONG / SHORT PIONEER TOOLS), CAMPFIRE BOX, 3KW GENERATOR, TRAILER, M-26 DETECTORS
		NON-ASSIGNABLE EQUIPMENT RADIO
	10	

NOMINAL TEAM STRUCTURE ORGANIZATIONAL CHART

1. TEAM TYPE COMBAT ENGINEER SQUAD, MECHANIZED	3. PREPARER R.J. HAIN, APPLIED SCIENCE ALLOC. 412-586-9773	5. PAGE <u>1</u> OF <u>1</u>
2. SOURCE(S) SNE INTERVIEWS AT FT BELVOIR WITH SCS LOVE, GERTON, AND RUCKS	4. DATE <u>04</u> / <u>30</u> / <u>82</u>	

6. ORGANIZATION CHART



GENERAL MISSION INFORMATION

FORM 3

1. TEAM TYPE COMBAT ENGINEER SQUADS, MECHANIZED	3. SOURCE(S) DIRECT OBSERVATION AT FORT POLK, ARL 5-145, P 2-32	5. PAGE 1 OF 1
2. MISSION TITLE 5-19 CONDUCT BRIDGE RECONNAISSANCE	4. PREPARER R.S. HEITS, APPLIED SCIENCE ASSOC. 412-584-7974	6. DATED 04 / 30 / 81

7. BRIEFLY DESCRIBE THE GOAL OF THE MISSION: ARL 5-145 (PAGE 2-32), STATES "... RECONNAISSANCE MUST BE MADE TO SECURE INFORMATION ON FRIENDLY MOBILITY OR HOW TO DISRUPT OFFER MOBILITY..." IN THE FIELD ENGINEER OBSERVED THE RECONNAISSANCE WAS PERFORMED TO GATHER INFORMATION FOR A TARGET FOLDER. IT WAS ASSUMED ANOTHER FOLDER OR SQUAD WOULD DESTROY THE BRIDGE.

8. SPECIFY THE CRITERIA OR MEASURE OF SUCCESS.
ARL 5-145 (PAGE 2-32) STATES "RECONNAISSANCE TERMS MUST OUTLINE INFORMATION REQUIRED, AVOID OFFER CONTACT, REPORT BY SECURE METHOD, AND REPORT BY THE COUNCIL IN ORDER, AT LEAST 75% OF RECONNAISSANCE PARTY MUST BE ABLE TO PLATE THE OBJECTIVE AND HAZARD OF OBTAINING INFORMATION BEFORE RETIREMENT."

9. SPECIFY KNOWN CONDITIONS (E.G., ENVIRONMENT FACTOR, ENEMY SITUATIONS)
OFFER WAS IN AREA, NO ADVERSE ENVIRONMENTAL CONDITIONS

10. SPECIFY NONORGANIC SUPPORT REQUIRED USED:
PHOTOCOPYING EQUIPMENT NEEDED, BUT NOT AVAILABLE

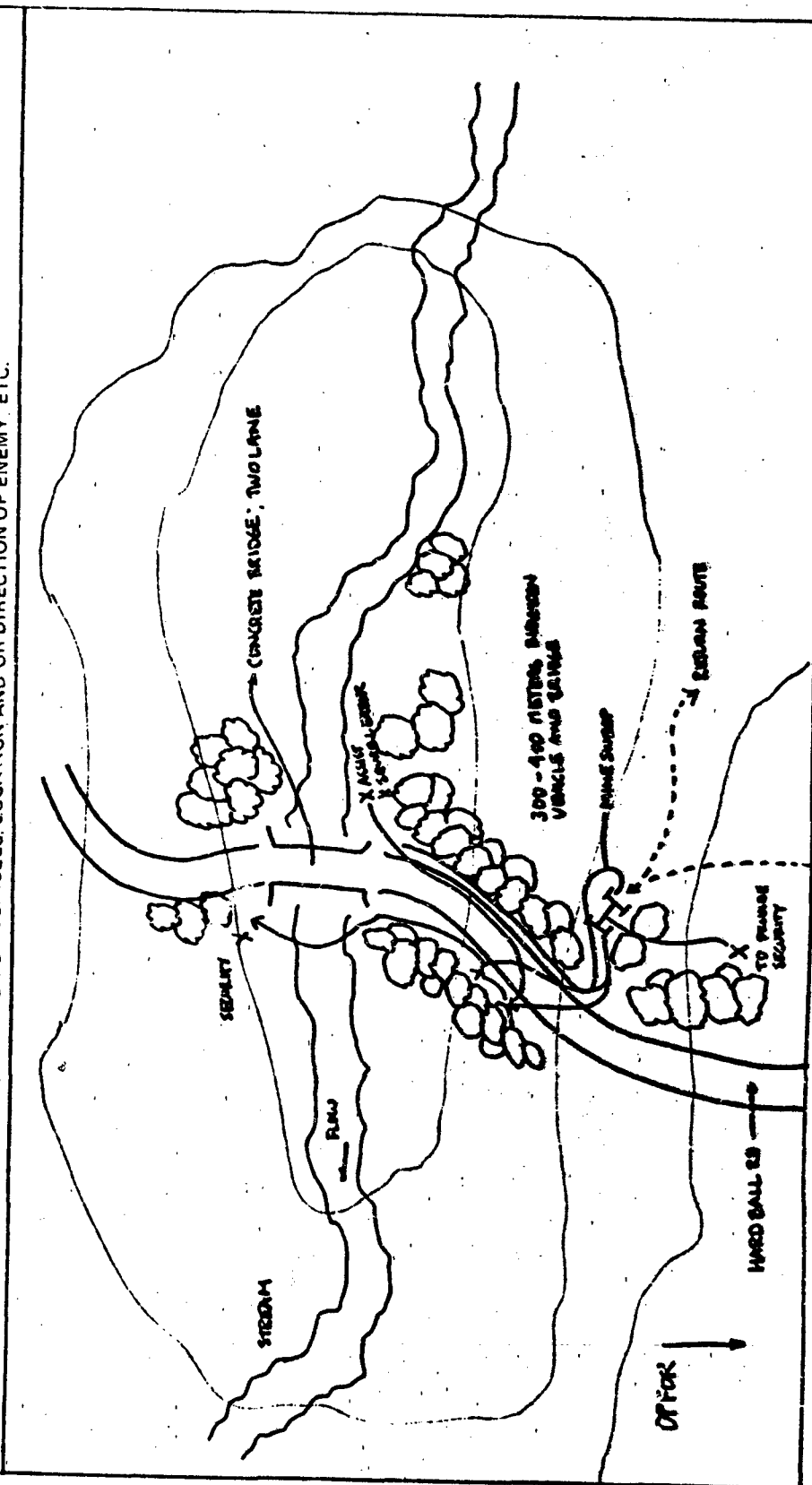
11. SPECIFY ANY ASSUMPTIONS
SQUAD WAS ONLY COMPOSED OF 5 TEAM MEMBERS, RADIO WAS MALFUNCTIONING SO COULD NOT CONFIRM PLATOON SET ON TRAIL OF ALLISON COMPLETION, SQUAD WOULD WAS NEW AND TEAM WERE NOT RECORDED MISSING AS A TEAM

12. ADDITIONAL NOTES OR COMMENTS (E.G., SPECIFY KNOWN EQUIPMENT DEFICIENCIES)
TRACK INTERCOM WAS MALFUNCTIONING; TWO RECONNAISSANCE WERE TEMPORARILY IN ONE ALLISON, ONLY ONE IS DESCRIBED
TEAM MOVED TO LOCATION 200-YARD FROM BRIDGE, GUNNER SUMMIT OFF TRACK TO PROVIDE SECURITY TO RIGHT OF VEHICLE, A TEAM MEMBER TOOK FINE SHOTTER TO SUPER ARMY FROM BRIDGE TO BRIDGE, ASSISTANT SQUAD LEADER CALLED ROAD TO PROVIDE TEMPORARY SECURITY DURING FINE SHOT, ANOTHER TEAM MEMBER STAYED TO CATCH TRACK, OTHER ASSUMED GUNNER'S POSITION ON TRACK TO PROVIDE SECURITY, AFTER CROSSING THE SQUAD MEMBER TOOK TO RECORD INFORMATION FOR SECURITY, SQUAD USED TO SECURITY LOCATION, SL AND ASL MOVED TO BRIDGE, TOOK MEASUREMENTS AND PHOTO SKETCHES, ALL MEMBERS RETURNED TO TRACK.

MISSION SITUATIONAL MAP

1. TEAM TYPE: COMBAT ENGINEER SQUAD, MECHANIZED	3. SOURCE(S): DIRECT OBSERVATION AT FC POLK	5. PAGE <u>1</u> OF <u>1</u>
2. MISSION TITLE: S-19 CONDUCT BRIDGE RECONNAISSANCE	4. PREPARER: S.J. WRIGHT, ARMED CORPS ASSOC. 412-586-7774	6. DATE: <u>04</u> / <u>30</u> / <u>82</u>

7. MISSION SITUATIONAL MAP. INDICATE ROADS, BRIDGES, TREES, POSITION OF TEAM MEMBERS, MOVEMENT OF TEAM MEMBERS, DISTANCES BETWEEN OBJECTS AND PERSONNEL, LOCATION OF VEHICLES, LOCATION AND OR DIRECTION OF ENEMY, ETC.



ACTUAL TEAM STRUCTURE

FORM 4

1. TEAM TYPE COMBAT ENGINEER SQUAD, MECHANIZED	3. SOURCE(S) DIRECT OBSERVATION AT PT POLK; INTERVIEWS WITH TEAM MEMBERS	5. PAGE <u>1</u> OF <u>4</u>
2. MISSION TITLE 5-19 CONDUCT BRIDGE RECONNAISSANCE	4. PREPARER R.J. HARTZ, APPLIED SCIENCE ASSOC. 412-566-7773	6. DATE <u>04</u> / <u>30</u> / <u>87</u>

7. POSITION TITLE & MOS CODE	8. NUMBER	9. EQUIPMENT ASSIGNED OR USED	10. MISSION FUNCTION PERFORMED. INDICATE IF MEMBER OF VESTED TEAM
SQUAD LEADER 12B30 (E-6)	1	NOTEBOOK, PENCIL, LENSATIC COMPASS, JOD BOOK (M), M-16, MAP, TAPE MEASURE	ISSUED OPERATIONS ORDER, SUPERVISED ENROUTE, ASSIGNED RESPONSIBILITIES AT SITE, MADE SKETCHES AT SITE, TOOK MEASUREMENTS WITH ASL
ASSISTANT SQUAD LEADER 12B10(E-4)	1	SHARED MEASURING TAPE WITH SQUAD LEADER, M-16	PROVIDE SOME DIRECTION AT SITE FOR SECURITY TEAM, MAINLY WORKED WITH SL TO TAKE BRIDGE MEASUREMENTS (PARTICIPATED IN DECISIONS CONCERNING HOW TO MEASURE STRUCTURES), UNDER SL DIRECTIONS
VEHICLE DRIVER 12F10 (E2)	1	M-16	DROVE TRUCK TO SITE, THEN ASSUMED COMMAND POSITION TO PROVIDE SECURITY
CONSTRUCTION ENGINEERS 12B30 (E-2 AND E-3)	2	ONE USED MINE DETECTOR AND M-16, OTHER USED M16 AND AN AKE	UPON ARRIVAL AT SITE ONE MEMBER REPAIRED THE MINE SWEEP, AFTER MINE SWEEP WAS OVER THE MEMBER TOOK A SECURITY POSITION ON THE BACK SIDE OF THE BRIDGE. THE OTHER MEMBER IMMEDIATELY ASSUMED A SECURITY POSITION, UNTIL THE MINE SWEEP WAS FINISHED, HE THEN LEFT THE SECURITY POSITION TO CAPTIVE THE TRUCK.
		NOTE: RADIO WAS MALFUNCTIONING	NOTE: VEHICLE DRIVER AND THE TWO CONSTRUCTION SPECIALISTS COULD BE TURNED AS A SECURITY MEASURE TEAM, WHILE THE SL AND AKE COULD BE TURNED AS A DATA GATHERING MEASURE TEAM.
		5	

ACTUAL TEAM STRUCTURE NESTED TEAM DESCRIPTION

1. TEAM TYPE COMBAT ENGINEER SQUAD, MECHANIZED	3. SOURCE(S) DIRECT OBSERVATION AT PT PONS	5. PAGE <u>1</u> OF <u>1</u>
2. MISSION TITLE S-19 CONDUIT BRIDGE RECONNAISSANCE	4. PREPARER: R.T. WHITE, APPLIED SCIENCE ASSOCIATES 412-526-7711	6. DATE: <u>04</u> / <u>30</u> / <u>92</u>

7. NESTED TEAM NAME	8. NUMBER OF MEMBERS	9. FUNCTION & MISSION PHASE	10. DESCRIPTION OF FORMATION
SECURITY NESTED TEAM	3 MAX 2 MIN	PROVIDED SECURITY DURING MECHANIZED TAKING PHASE. ALTHOUGH THEY ARE CALLED A SECURITY TEAM, THEY WERE NOT A GROUP THEY WERE INDIVIDUALS WHO WERE ALL ASSIGNED THE SAME FUNCTION BY THE ASL AND SL. THE ASL WAS PART OF THE TEAM IN THE BEGINNING WHEN THE MINE SWEEP WAS BEING PERFORMED, THUS THE SIZE OF THE TEAM VARIED FROM 2 MEMBERS AT THE BEGINNING OF THE MISSION TO 3 MEMBERS DURING THE MAIN PART OF THE MISSION.	ASSIGNMENT WAS MADE DURING THE OPERATIONS ORDER AND DURING THE MAIN PART OF THE MISSION ITSELF SL GAVE ORDER FOR DISBANDING TEAM AT END OF MISSION
RECONNAISSANCE TEAM	2	COMBINED OF SL AND ASL, TOOK MECHANIZED AND MADE SECURES.	ASSIGNMENT MADE DURING OPS ORDER.

MISSION/TEAM ACTIVITY DESCRIPTION

FORM 5

1. TEAM TYPE: COMBAT ENGINEER SQUAD, MECHANIZED		3. SOURCE(S): DIRECT OBSERVATION AT PT POLK		5. PAGE <u>1</u> OF <u>13</u>	
2. MISSION TITLE: 5-19 CONDUCT BRIDGE RECONNAISSANCE		4. PREPARER: R.J. HEITS, ARMED GUARD ASSOCIATES 412-586-7711		6. DATE: <u>04</u> / <u>30</u> / <u>82</u>	
7. NESTING: (Y) N		3. <input checked="" type="checkbox"/> EACH NESTED TEAM DESCRIBED SEPARATELY <input type="checkbox"/> NESTED TEAM DESCRIBED TOGETHER		9. NESTED NAME	

10. MISSION/TEAM ACTIVITIES	11. TEAM MEMBERS						12. DEPENDENCY INFORMATION	13. ADDITIONAL NOTES
	1	2	3	4	5	6		
SL RECEIVED ORDER FROM PLATOON LEADER	R						<p>SL = SQUAD LEADER, ASL = ASSIST SQUAD LEADER, VD = VEHICLE DRIVER, CS1 AND CS2 = DEMOTE CONSTRUCTION SPECIALISTS 1 AND 2.</p> <p>THIS ACTIVITY WAS NOT OBSERVED BUT INTERVIEW SQUAD LEADER INDICATED THAT THE ORDER WAS GIVEN ORALLY. CONTENT OF ORDER (DEPENDENCY BLANKET) UNKNOWN, THEREFORE PURPOSE UNKNOWN, SUSPECT ORDER INCLUDED OFFER LOCATION, COORDINATES OF BRIDGE, STATUS OF EQUIPMENT, ETC.</p> <p>ORDER ISSUED 12 HOURS BEFORE MISSION</p>	
MISSING PLANNING ACTIVITIES							<p>DEPENDENCIES AND PARTICIPANT UNKNOWN -- ACTIVITY WAS NOT OBSERVED. SL WAS NOT INTERVIEWED ABOUT PLANNING ACTIVITIES DUE TO TIME LIMITS</p> <p>NOT OBSERVED</p>	
SL ISSUES FRAG ORDER TO TEAM MEMBERS, APPROXIMATELY 30 MINUTES TO MISSION DEPARTURE	I	R	R	R	R	R	<p>SL [2,3,4,5] DC OED, SP, SS, SE, SMO</p> <p>CONTENT OF ORDER: DETERMINE TIME OF DEPARTURE, TIME OF RETURN, OFFER SHORTAGE, INDIVIDUAL ASSIGNMENTS, STATUS OF EQUIPMENT, MISSION PROCEDURES, ROUTE AND RETURN ROUTE, TYPE OF SECURITY, AVOID ENEMY CONTACT</p> <p>INDIVIDUALS ASKED QUESTIONS DURING ISSUE -- E.G., "WHAT TIME DO WE RETURN?"</p>	

MISSION/TEAM ACTIVITY DESCRIPTION

1. TEAM TYPE:		3. SOURCE(S)		5. PAGE <u>7</u> OF <u>13</u>			
2. MISSION TITLE		4. PREPARER		6. DATE <u> </u> / <u> </u> / <u> </u>			
7. NESTING Y N	8. <u> </u> EACH NESTED TEAM DESCRIBED SEPARATELY <u> </u> NESTED TEAM DESCRIBED TOGETHER						
10. MISSION TEAM ACTIVITIES		11. TEAM MEMBERS			12. DEPENDENCY INFORMATION		
		1	2	3	4	5	13. ADDITIONAL NOTES
SL(2) DISCUSSED ASSIGNMENTS WITH ALL TEAM MEMBERS INDIVIDUALLY.		I	R				ELEMENT - CONSISTED OF INDIVIDUAL REFINISHING AND ASSIGNMENTS -- WHAT TO DO WHEN DURING THE ACTIVITY SOME TEAM MEMBERS WERE TRYING TO GET THE RATED TO WORK - THESE DISTURBANCES ARE NOT SHOWN.
		I		R			
		I			R		
		I				R	
SL(1) ISSUES ORDER TO MOUNT VEHICLE TO ALL TEAM MEMBERS		I	R	R	R	R	CD 1 2,3,5 ODD ELEMENT "MOVE OUT"
SL(1) DID NOT MOUNT VEHICLE - STAYED ON GROUND TO PROVIDE DIRECTION TO DRIVER IN ORDER BACK-UP VEHICLE							
ASL(2) MOUNTED VEHICLE							
VD(3) MOUNTED VEHICLE AND STARTED ENGINE							
CS-2(4) MOUNTED REAR OF TRUCK TO ASSIST IN REMOVING CANTONMENTS							
CS-2(5) MOUNTED REAR OF TRUCK TO ASSIST IN REMOVING CANTONMENTS							
							✓ DENIES INDIVIDUAL ACTIVITIES AFTER LAST DEPENDENCIES
							5 DID NOT MOUNTED VEHICLE WHEN 4 DID, 5 RELEASED THE CANTONMENT PILES THEN MOUNTED THE VEHICLE.

MISSION/TEAM ACTIVITY DESCRIPTION

1. TEAM TYPE		3. SOURCE(S)		5. PAGE <u>3</u> OF <u>13</u>	
2. MISSION TITLE		4. PREPARER		6. DATE <u> </u> / <u> </u> / <u> </u>	
7. NESTING		8. EACH NESTED TEAM DESCRIBED SEPARATELY		9. NESTED NAME	
10. MISSION/TEAM ACTIVITIES		11. TEAM MEMBERS		12. DEPENDENCY INFORMATION	
		1 2 3 4 5		13. ADDITIONAL NOTES	
DRIVER (1) BACKS UP TRUCK WHILE 4 AND 5 LIFT CAMO SO VEHICLE WOULD BE IN SE. PASS UNDER CAMO	I R R 1/2 I/R			<p>THERE ARE TWO DEPENDENCIES INVOLVED IN THIS ACTIVITY.</p> <p>3 $\xrightarrow{[4,5]}$ P2 SE, SSA</p> <p>ELEMENT: DRIVER BACKING-UP GIVING INDICATION THAT 4'S SHOULD START LIFTING CAMO</p> <p>4 $\xrightarrow{\quad}$ 5 P2 SSA, SE</p> <p>ELEMENT: 4 & 5 LIFTING AND ROLLING CAMO SO VEHICLE CAN PASS</p>	DEPENDENCY REQUIRES CONSIDERABLE COORDINATION MUST LIFT AND ROLL TOGETHER
CS-1 (4) DISMOUNTS VEHICLE AFTER CAMO IS CLEARED BY VEHICLE	✓				V = INDIVIDUAL ACTIVITY DISMOUNTS TO HELP GIVE DIRECTIONS TO DRIVER
DRIVER (3) RECEIVES DIRECTIONS FOR BACKING-UP VEHICLE	I R I/R			<p>1 $\xrightarrow{121}$ 4 $\xrightarrow{121}$ 3 N1 030, 15, PC</p> <p>ELEMENT: HANDSIGNALS ARE USED FOR DIRECTIONS AND FOR CORRECTIVE FEEDBACK ACTION:</p>	<p>DRIVER (3) CANNOT SEE TO BACK-UP, IN ADDITION HE CAN NOT TURN, AROUND AND MUST FACE FORWARD. CS-1 (4) POINTING HIMSELF TO THE FRONT SIDE OF THE VEHICLE, THE SQUARE LOWER PORTIONS HIMSELF IN THE REAR OF THE VEHICLE. SL (8) GIVES HANDSIGNALS TO 4, WHO REPEATS THEM TO 3 (DRIVER).</p> <p>HANDSIGNALS MAY BE SUPPORTED WITH ORAL DIRECTIONS OR INSTRUCTIONS.</p>

MISSION/TEAM ACTIVITY DESCRIPTION

FORM 5

1 TEAM TYPE	3 SOURCE(S)		5 PAGE 4 OF 13	
2 MISSION TITLE	4 PREPARER		6 DATE	
7 NESTING Y	3 EACH NESTED TEAM DESCRIBED SEPARATELY NESTED TEAM DESCRIBED TOGETHER		9 NESTED NAME	

10 MISSION TEAM ACTIVITIES	11 TEAM MEMBERS					12 DEPENDENCY INFORMATION	13 ADDITIONAL NOTES
	1	2	3	4	5		
VEHICLE IS BACKED-UP SL (1) AND (5-2) (4) FRONT VEHICLE	✓			✓			THERE IS SOME CONFUSION DURING THIS ACTIVITY BECAUSE MANY INDIVIDUALS ARE TRYING TO GIVE DIRECTIONS TO THE DRIVER - HOWEVER THE DRIVER APPENDS TO "KNOW" WHO HE IS TO TAKE DIRECTIONS FROM
START TO LEAVE BRNVC AREA							INDIVIDUAL ACTIVITY
SL (3) HAS COMMUNICATION WITH AREA SECURITY GUARD	R					<div style="text-align: center;"> E 121 → 2 121 → 3 121 → 4 121 → 5 CD CONTENT OF COMMUNICATION NOT RECORDED </div>	
SL (1) PROVIDES DIRECTIONAL DIRECTIONS TO THE DRIVER(S) VIA THE ASL (2)	I	R	R			<div style="text-align: center;"> 121 → 2 121 → 3 121 → 4 121 → 5 CD; ASD, FC EQUIPMENT: DIRECTIONAL AND INSTRUCTION TO DRIVER </div>	THE INTERCOM WAS MALFUNCTIONING AND THE SL COULD NOT COMMUNICATE TO THE DRIVER TO OVERCOME THIS PROBLEM THE SL WOULD VERBALLY COMMUNICATE TO THE ASL, WHO WOULD GIVE SIGNALS TO THE DRIVER WITH A STICK (C.A. ATTY ON THE RIGHT SIDE OF THE INTERCOM TURN RIGHT) OFTEN ASL WOULD MINUTE SIGNALS ON HIS DATA KNOWING THE DIRECTION OF SL.

MISSION/TEAM ACTIVITY DESCRIPTION

FORM 15

1. TEAM TYPE		3. SOURCE(S)		5. PAGE <u>5</u> OF <u>13</u>	
2. MISSION TITLE		4. PREPARER		6. DATE: ____/____/____	
7. NESTING Y N		5. EACH NESTED TEAM DESCRIBED SEPARATELY ____ NESTED TEAM DESCRIBED TOGETHER		9. NESTED NAME	

10. MISSION TEAM ACTIVITIES	11. TEAM MEMBERS					12. DEPENDENCY INFORMATION	13. ADDITIONAL NOTES
	1	2	3	4	5		
RECEIVES DIRECTION FROM SLIA ASL AND ACTS ACCORDINGLY				✓			INDIVIDUAL ACTIVITY
EXEUTE A SRE - 300 TO 400 METERS FROM BRIDGE							MISSION EXECUTION PHASE
ASL AUTOMATICALLY MOVE ACROSS ROAD WITH N-16 TO PROVIDE SECURITY		✓					INDIVIDUAL ACTIVITY; SL DID NOT ISSUE ORDER, MOVEMENT WAS AUTOMATIC.
ASL ESTABLISHES SECURITY POSITION AND PROVIDES SECURITY	R	I	R	R	R	2. [1,3,9,5] P2 ELEMENT'S PURPOSE: PROVIDE SECURITY	
GUNNER VACATES POSITION AND MOVES TO LEFT OF VEHICLE 300 N OF THE ROAD (SAME SIDE AS VEHICLE) TO TAKE SECURITY POSITION			R	I		9. → 3 P2, SIA ELEMENT: 4 MOST HAVE BEFORE 3 CAN TAKE POSITION	
DRIVER TAKES GUNNER'S POSITION			✓				INDIVIDUAL ACTIVITY
CS-1 (4) (GUNNER) ASSUMES SECURITY POSITION AND PROVIDES SECURITY	R	R	R	I	R	V. 1,2,3,5 ELEMENT: SECURITY	INDIVIDUALS 2 AND 4 ARE NOW MEMBERS OF THE NESTED SECURITY TEAM
DRIVER NOW PROVIDES SECURITY FROM TRACK	R	R	R	I	R	V. 3 5,2,4,5 ELEMENT: SECURITY	3 JOINS 2 AND 4 IN PROVIDING SECURITY V. [2,3,4] → [5] SECURITY ELEMENTS

MISSION TEAM ACTIVITY DESCRIPTION

FORM 15

1. TEAM TYPE		3. SOURCE(S)		5. PAGE <u>6</u> OF <u>13</u>	
2. MISSION TITLE		4. PREPARER		6. DATE: ____/____/____	
7. NESTING Y N		8. ____ EACH NESTED TEAM DESCRIBED SEPARATELY ____ NESTED TEAM DESCRIBED TOGETHER		9. NESTED NAME	

10. MISSION TEAM ACTIVITIES	11. TEAM MEMBERS					12. DEPENDENCY INFORMATION	13. ADDITIONAL NOTES
	1	2	3	4	5		
SL ISSUES ORDER TO (S) TO ASSEMBLE MINE DETECTOR	I	I	I	I	R	1 → 5 CD, O/D ELEMENT: "ASSEMBLE MINE DETECTOR"	
CS-2 (3) ASSEMBLES DETECTOR WITH SOME ASSISTANCE FROM SL(1)	I	I	I	I	R	1 → 5 P2, SE ELEMENT: TOGETHER ASSEMBLE MINE DETECTOR	SOME ORAL COMMUNICATION BETWEEN 1 & 5 DURING ASSEMBLY ACTIVITY
ISSUES ORDER TO START MINE SWEEP	I	I	I	I	R	1 → 5 CD, O/D ELEMENT: START MINESWEEP AND WALK DOWN TO BRIDGE	SUPPLIES VERBAL INSTRUCTIONS BY POINTING TO LOCATIONS
STARTS MINE SWEEP		I	I	I	✓		INDIVIDUAL ACTIVITY
DURING SWEEP A MEMBER OF THE SECURITY TEAM, OFFERED "VEHICLE COMING" CAUTION 5 TO TAKE COVER	I	I	I	I	R	2,3, OR 4 → 5 CD, O/D ELEMENT: VEHICLE - TAKE COVER	5 WOULD MOVE TO COVER; HOWEVER OFFER 5 WOULD NOT.
WHILE SWEEP IS BEING PERFORMED, SL(1) ISSUES ORDER TO (4) TO COMFOURAGE VEHICLE, (4) RECEIVES	I	I	I	I	R	1 → 4 CD, O/D ELEMENT: "CAMOUFLAGE VEHICLE"	
CS-2 (4) MOVES FROM POSITION AND OBSERVES AVE					✓		INDIVIDUAL ACTIVITY

MISSION/TEAM ACTIVITY DESCRIPTION

1 TEAM TYPE		3 SOURCE(S)		5 PAGE <u>7</u> OF <u>13</u>	
2 MISSION TITLE		4 PREPARER		6 DATE <u> </u> / <u> </u> / <u> </u>	
7 NESTING	Y N	8 <u> </u> EACH NESTED TEAM DESCRIBED SEPARATELY <u> </u> NESTED TEAM DESCRIBED TOGETHER		9 NESTED NAME	

10. MISSION TEAM ACTIVITIES	11 TEAM MEMBERS					12. DEPENDENCY INFORMATION	13. ADDITIONAL NOTES
	1	2	3	4	5		
CS-1 (4) STRUTS TO CUT BRUSH TO COMBARGE VEHICLE	↑	↑	↑	✓	↑		INDIVIDUAL ACTIVITY
CS-1 (4) COMPLETES ACTIVITY AND RETURNS TO SECURITY POSITION	↑	↑	↑	✓	↑	NOTE: 3 → 4 ELEMENT: "DO NOT TAKE BRUSH FROM FRONT OF VEHICLE"	INDIVIDUAL ACTIVITY
CS-2 (5) COMPLETES RING SWEEP	R	R			I	ALTHOUGH COMPLETING THE RING SWEEP IS AN INDIVIDUAL ACTIVITY, THE CLEAR AREA IS DIVIDED BY 4 & 2, THUS 5 → [4,2] P2 ELEMENT: CIRCLED AREA	
	R	R	R	R	I	DURING SWEEP THE OTHER MUST STAY A SAFE DISTANCE FROM THE COUNTER 5 → [4,2,1] ← P2 ELEMENT: SAFE DISTANCE	
SL (4) CARRIES (1-16 OF G) TO ASL AND RETURNS TO VEHICLE	I	R	↑	↑	↑	1 → 5 P1, SE ELEMENT: TRANSFER OF RIFLE	
CS-2 (5) PUTS DEFENSE AWAY AND COMPLETES ACTIVITY		↑	↑	↑	✓		INDIVIDUAL ACTIVITY

MISSION/TEAM ACTIVITY DESCRIPTION

FORM 5

1. TEAM TYPE		3. SOURCE(S)		5. PAGE <u>8</u> OF <u>13</u>	
2. MISSION TITLE		4. PREPARER		6. DATE: ____/____/____	
7. NESTING Y N		8. ____ EACH NESTED TEAM DESCRIBED SEPARATELY ____ NESTED TEAM DESCRIBED TOGETHER		9. NESTED NAME	

10. MISSION TEAM ACTIVITIES	11. TEAM MEMBERS					12. DEPENDENCY INFORMATION	13. ADDITIONAL NOTES
	1	2	3	4	5		
SL(1) MOVES TO SECURITY POSITION OF CS-1(4) AND ASKS HOW FAR UP THE ROAD HE CAN SEE	I	I	I	R		1 → 4 CD, SIA ELEMENT: "HOW FAR DOWN THE ROAD CAN YOU SEE"	
SL(1) REMAINS TO VEHICLE AND ORDERS (5) TO SEE ASL ON OTHER SIDE OF ROAD	I	I	I	R		1 → 5 CD, SIA ELEMENT: "SEE ASL"	
ASL(2) ORDERS (5) TO TAKE A SECURITY POSITION ALONG THE BRIDGE, TRANSFER MIC TO (5)		I	I	R		2 → 5 PS, SE ELEMENT: TRANSFER OF MIC 2 → SCD, SIA ELEMENT: TAKE SECURITY POSITION	ASL(2) NOW LEAVES SECURITY TEAM, (5) TAKES SECURITY TEAM.
CS-2(5) MOVES INTO POSITION				✓			INDIVIDUAL ACTIVITY
SL GETS THE MESSAGE AND BEGINS TO MOVE TOWARD BRIDGE							
ASL BEGINS TO MOVE TOWARD BRIDGE							
THEY MEET 1/2 WAY TO BRIDGE ON SWIFT SIDE AND EXCHANGE WORDS	R	I	I			2 → 1 CD, SE ELEMENT: "DO YOU HAVE THE MESSAGE"	

MISSION TEAM ACTIVITY DESCRIPTION

FORM 15

1. TEAM TYPE		3. SOURCE(S)		5 PAGE <u>9</u> OF <u>13</u>	
2. MISSION TITLE		4. PREPARER		6 DATE: ____/____/____	
7. NESTING Y N		3. ____ EACH NESTED TEAM DESCRIBED SEPARATELY ____ NESTED TEAM DESCRIBED TOGETHER		9. NESTED NAME	

10. MISSION TEAM ACTIVITIES	11. TEAM MEMBERS					12. DEPENDENCY INFORMATION	13. ADDITIONAL NOTES
	1	2	3	4	5		
SL(1) AND ASL(2) MOVE TO BRIDGE ABUTMENT FOR SOME CONCERTATION							INDIVIDUAL ACTIVITY 3, 4, 5 CONTINUE TO PASSAGE SECURITY
SL(1) BEGINS TO READ FIELD MANUAL; ASL(2) HOLDS FIELD MANUAL	I	R				1 → 2 P2; SS NOTICE: (2) HOLD PM SO (2) CAN EXACTLY READ IT	SECURITY CONTINUES
SL(2) AND ASL(2) DISCUSS HOW THEY ARE GOING TO MEASURE SOME OF THE STRUCTURES	S/R	W/I				1 → 2 → 3 CD, P2; PS ELEMENT: PLAN FOR MEASURING STRUCTURES	SECURITY CONTINUES [3, 4, 5] → [3, 2] ✓ ELEMENT: SECURITY
SL(1) AND ASL(2) START TO TAKE MEASURES. SL(1) HOLD ONE END OF TAPE MEASURE, WHILE ASL(2) HOLDS OTHER END OF TAPE MEASURE	I	R				1 → 2 P2; SE, DID ELEMENT: NECESSITY TO MANIPULATE THE TAPE MEASURE	
WHEN TAPE MEASURE IS REELLED OUT ASL(2) TELLS-OUT THE MEASURE AND SL(1) BEGINS THE MEASURE	R	I				2 → 1 P2; SE ELEMENT: MEASUREMENT IS TRANSFERRED	ON THIS FIRST MEASUREMENT THE ASL(2) NEED NOT KNOW HOW TO AUTOMATICALLY REEL IN THE TAPE, HE RECEIVED DIRECTION FROM (1) 1 → 2 CD, SE
							THE FOLLOWING ARE MEASURED. SL PROVIDES THE SEQUENCE (1) WIDTH OF BRIDGE (2) BOTTOM OF BRIDGE

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MISSION/TEAM ACTIVITY DESCRIPTION

FORM 5

1. TEAM TYPE		3. SOURCE(S)		5. PAGE <u>10</u> OF <u>13</u>	
2. MISSION TITLE		4. PREPARER		6. DATE <u> </u> / <u> </u> / <u> </u>	
7. NESTING Y N		8. <u> </u> EACH NESTED TEAM DESCRIBED SEPARATELY <u> </u> NESTED TEAM DESCRIBED TOGETHER		9. NESTED NAME	

10. MISSION TEAM ACTIVITIES	11. TEAM MEMBERS					12. DEPENDENCY INFORMATION	13. ADDITIONAL NOTES
	1	2	3	4	5		
SL(1) AND ASL(2) MOVE UNDER THE BRIDGE TO TAKE SOME MEASUREMENTS	✓	✓					SECURITY CONTINUES
ASL(2) KNOWS WHAT MEASUREMENTS TO TAKE AND AUTOMATICALLY STRAYS WITHOUT INSTRUCTION FROM SL(4)		✓					
ASL(2) TAKES MEASURES AND YELLS THEM TO SL(1)	R						
SL(4) RECORDS THEM	✓						
BOTH SL(4) AND ASL(2) READ THE BOOK AND DETERMINE WHAT OTHER MEASURES MUST BE TAKEN	✓	✓					SECURITY CONTINUES
SL(1) DIRECTS ASL(2) TO TAKE SOME ADDITIONAL MEASURES	I					1 → 2 CD; OZD ELEMENT: INSTRUCTION TO TAKE ADDITIONAL MEASURES	
ASL(2) TAKES MEASURES	✓						
ASL(2) YELLS MEASURES TO SL(1)	R					2 → 1 CD; DATA ELEMENT: TRANSMISSION OF DATA	
SL(1) RECORDS THE MEASURES	✓						

MISSION/TEAM ACTIVITY DESCRIPTION

1. TEAM TYPE		3. SOURCE(S)		5. PAGE <u>11</u> OF <u>13</u>	
2. MISSION TITLE		4. PREPARER		6. DATE: ____/____/____	
7. NESTING Y N		3. EACH NESTED TEAM DESCRIBED SEPARATELY NESTED TEAM DESCRIBED TOGETHER		9. NESTED NAME	

10. MISSION TEAM ACTIVITIES	11. TEAM MEMBERS					12. DEPENDENCY INFORMATION	13. ADDITIONAL NOTES
	1	2	3	4	5		
SL(1) AND ASL(1) MOVE TO THE BUNKER IN ORDER TO MAKE THE NECESSARY SKETCHES	✓	✓	✓	✓	✓		
WHILE MAKING SKETCHES (NOTE: SL(1) IS MAKING THE SKETCHES AT AN INDIVIDUAL ACTIVITY), SL(1) REALIZES THAT ADDITIONAL DATA IS NEEDED • FLOW OF SKECH • ADJUTANT SIZE							
SL(1) ORDERS ASL(1) TO DETERMINE DIRECTION OF FLOW	I	R				1 → 2 CD; DSD ELEMENT: DIRECTION	
ASL(1) DETERMINES FLOW AND REPORTS IT TO SL(1)	R	I				2 → 1 CD; DATA ELEMENT: TURN NUMBER OF FLOW	
SL(1) RECORDS FLOW ON SKETCH	✓						
SL(1) INFORMS ASL(1) ADJUTANT IS TO BE FURNISHED	I	R				1 → 2 CD; DSD ELEMENT: 'NEEDS TO REORGANIZE ADJUTANT	
BOTH SL(1) AND ASL(1) MOVE TO ADJUTANT	✓	✓					

MISSION/TEAM ACTIVITY DESCRIPTION

FORM 5

1. TEAM TYPE:		3. SOURCE(S)		5. PAGE <u>12</u> OF <u>13</u>	
2. MISSION TITLE:		4. PREPARER		6. DATE <u> </u> / <u> </u> / <u> </u>	
7. NESTING Y N	8. <u> </u> EACH NESTED TEAM DESCRIBED SEPARATELY <u> </u> NESTED TEAM DESCRIBED TOGETHER				
9. NESTED NAME					

10. MISSION TEAM ACTIVITIES	11. TEAM MEMBERS					12. DEPENDENCY INFORMATION	13. ADDITIONAL NOTES
	1	2	3	4	5		
SL(1) HEADS TYPE, WHILE ASL(1) REELS OUT TYPE	I	R				1 → 2 P2; SE ELEMENT: COORDINATION OF MANEUVERING EQUIPMENT	
ASL(2) YELLS MEASURE TO SL(4)	R	I				2 → 1 CD; DATA ELEMENT: MEASURE TURNING	
SL(3) REELS MESSAGE	✓						
SL(3) COMPLETES SKETCHES	✓						
SL(3) INSTRUCTS ASL(2) TO SURVEY SECURITY TEAM RETRY TO LEAVE	I	R				1 → 2 CD; OSD ELEMENT: INFORM OTHERS READY TO LEAVE	
ASL(1) MOVES TO CS-2(1) AND SUPPORTS RETRY TO LEAVE	I				R	2 → 5 CD; OSD ELEMENT: READY TO LEAVE	
SL(1), ASL(2), CS-2(1) WALK BACK TO TRACK	✓	✓			✓		SECURITY NESTED TEAM NOW REDUCED BY 1 MEMBER
ARRIVE AT TRACK SL(3) INFORMS CS-2(4) TO LEAVE SECURITY POSITION TELLS DRIVER TO GET TO DRIVER'S POSITION	I			R		1 → 4 CD; OSD ELEMENT: READY TO LEAVE	
	I			R		1 → 3 CD; OSD ELEMENT: GET INTO DRIVER'S POSITION	

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APPENDIX C

DESCRIPTION OF COMMON MISSION/TEAM ACTIVITIES

APPENDIX C

DESCRIPTION OF COMMON MISSION/TEAM ACTIVITIES

This Appendix is primarily designed to be a reference for the user of the description method. After a user identifies a mission activity, the user should determine if the mission activity is common enough to be included in this Appendix. If it is, then much of the work required to complete Block 12 of Form 5 can be minimized, since this document explains how the mission activity should be described and recorded.

The following common mission activities are discussed in this Appendix:

1. Issuance of orders to team leader by team-external person(s).
2. Issuance of warning orders to team members.
3. Issuance of operation frag orders to team members.
4. Issuance of other orders (e.g., directions or instructions).
5. Lifting and carrying heavy objects, which requires teamwork.
6. Loading or offloading supplies and materials from a vehicle as a team.
7. Aligning or directing a vehicle into a specific location.
8. Two or more individuals preparing a report or form.
9. Providing security.

For each of these nine activities, the following are presented:

1. A discussion of the variations in the common mission activities.
2. The standard pattern that should be used to describe the dependency.
3. The most appropriate dependency type to describe the activity.

4. The most appropriate dependency purposes to describe the activity.
5. A brief discussion of the dependency element.

Most of the information required in Block 12 of Form 5 is discussed for each mission activity.

Issuance of Orders to Team Leader by Team-External Person(s)

Variations and Patterns

Orders are typically issued at the beginning of a mission. Most frequently the order involves an external dependency. An individual outside the team of interest will give the order to the team leader (i.e., the leader of the team of interest). The external individual can give the order directly to the team leader on a one-to-one basis or to a group of individuals (of which one member of the group is the leader of the team of interest). These two variations have different patterns. The first pattern is a simple pattern with one initiator and one recipient (the leader of the team of interest). The second pattern is a fanout pattern with one initiator and multiple recipients (one or whom is the leader of the team of interest).

The first pattern can be graphically represented as:

E X | \longrightarrow 1 [1]

where the "E" denotes an external dependency, the "X" denotes the initiator is an individual outside the team of interest, the single arrowhead indicates a simple pattern, and "1" denotes that the recipient is the leader of the team of interest.

The fanout pattern can be represented as:

E X | Other + 1 \ll [2]

when the "E" denotes an external dependency, the "X" denotes the initiator is an individual outside the team of interest, the double caret (\ll) indicates a fanout pattern, and the phrase "Other + 1" denotes that others plus the leader of the team of interest (designated 1) are recipients of the order. For external fanout dependencies, it is not necessary to specify the other recipients, only those who are members of the team of interest. Thus, if two members of the team of interest received the order, then the pattern would be:

E X | Others + 1, 2 \ll [3]

where the symbols are the same, except the phrase "Others + 1, 2" denotes that included in the set of recipients was team members "1" and "2."

If the order involved a question and answer dialogue (assuming the order was issued verbally), then a "Z" format would be indicated. Pattern [1] would be represented as:

E X | Z | → 1 [4]

where the symbols are the same, except the "Z" denotes a "Z" format. A "Z" format would be indicated where the recipients are permitted the opportunity to ask questions or clarify the orders, and the initiator receives an opportunity to respond to the questions or clarifications. Pattern [2] would be represented in a "Z" format as:

E X | Z | Others + 1 << [5]

Again, the symbols are the same except the "Z" denotes a "Z" format.

Dependency Type

Orders are usually given verbally and directly. Sometimes, orders are written and notes presented verbally, and often they are issued both in written form (indirectly) and verbally (directly). If they are given only verbally, then the proper dependency type is CD (Direct Communication), represented as:

E X | Z | → 1 [6]

If the order is only given in written form, then the proper dependency type is CI (Indirect Communication), or:

E X | Z | → 1 [7]

If the order is issued both in written form and verbally, the most appropriate representation would be:

E X | Z | → 1 [8]

These codes, CI and CD, can also be used with pattern [2].

Dependency Element

The element for an order is the contents of the order. Typically, orders contain the following:

1. Objective of the mission.

2. Tactical approach of objective.
3. Status of equipment.
4. Status of supplies and materials.
5. Individual assignments (assignments to the various team leaders).
6. Friendly situation.
7. Enemy situation.
8. Execution of mission.

Thus, in block 12 under the sketch of the pattern, a phrase or codes would be entered indicating the content of the order.

Dependency Purpose

The major purpose of an order is to provide the information discussed above (the content of the order) to the participants in the mission. Thus from the content of the dependency element, the following purposes appear to be appropriate:

1. Orders, Instructions, Directions (OID).
2. Status of Individual Activity (SIA).
3. Status of Personnel (SP).
4. Status of Supplies (SS).
5. Status of Equipment (SE).
6. Information about the Mission Environment (IME).
7. Information about the Enemy (IMO).

These would be read in pattern [8] as:

E X | Z | CI, CD

 OID, SIA, SP, SS, SE, IME, IMO → 1

Issuance of Warning Orders to Team Members

Variations and Patterns

Warning orders are issued to alert the team that they will be participating in a mission soon. It is designed to communicate a "get ready" state. Warning orders are usually issued soon after the ops order.

Warning orders can be issued in a variety of ways. One method observed is for the team leader (who received the order) to issue the warning order to the assistant team leader(s) (say team member number 2). The assistant(s) then issue(s) the order to the remainder of the troops. This is by no means the only way warning orders are presented. This situation can best be represented as two separate patterns. First the passing of the order to the assistant:

1 | —————> 2 [1]

where "1" denotes the initiator (the team leader), the arrowhead denotes the direction of flow and a simple pattern, the "2" denotes the recipient (the assistant team leader). If the pattern has a "Z" format, then:

1 | Z | —————> 2 [2]

The "Z" format designation would indicate that the assistant asked questions concerning the mission.

The second pattern would indicate that the assistant, team member 2, issues the order to the rest of the team. This would be represented as a fanout pattern; i.e.,

2 | Z | 3, 4, . . . , N << [3]

where the "2" indicates the initiator is the assistant team leader, the "Z" denotes a "Z" format (only needed if the recipients asked questions about the upcoming mission), the recipients are denoted as team members "3 through N" (where N indicates the last team member number), and the double caret (<<) denotes a fanout pattern. Pattern [3] needs to specify if the assistant issued the order to the rest of the team as a group or individually. If each member was issued the order individually; then pattern [3] is proper. However, if the assistant issued the order to some team member as a group, then the following representation should be used:

2 | Z | [3, 4, . . . , N] << [4]

where the symbols are the same as in pattern [3], except the brackets ([]) around the recipients indicate the recipients were gathered together as a group to receive the order. If the assistant issued the order to some team members in a group and others individually, then a different sketch would be required. Those recipients who received the order in a group should be bracketed. Suppose team members 3, 6, and 7 were a group when the warning order was issued, and team members 4, 5, and 8 were seen individually by the assistant, then the most appropriate sketch would be:

$$\begin{array}{c} 2 \mid Z \mid [3, 6, 7] \ 4, 5, 8 \end{array} \ll \quad [5]$$

It should be noted that instead of two separate patterns, the patterns could be chained:

$$\begin{array}{c} 1 \mid Z \mid \end{array} \rightarrow \begin{array}{c} 2 \mid Z \mid [3, 4, \dots, N] \end{array} \ll \quad [6]$$

The first part of the pattern represents the simple flow between the team leader and the assistant, while the second part of the pattern represents fanout pattern between the assistant and the rest of the team members.

Warning orders have also been observed as being issued in a propagation pattern. Here the team leader issues the order to the assistant who issues it to the next team member, etc., until all team members have received the order. The correct sketch would be:

$$\begin{array}{c} 1 \mid 2, 3, 4, \dots, N \end{array} \quad [7]$$

where the "1" denotes the team leader, the vertical bar (|) represents a propagation pattern, and the team members receiving the order and passing it to the next team member are represented as 2, 3, 4, ..., N. Notice the team members are recipients and initiators. The team members should be listed in their observed sequence; e.g., if "2" received and passed to "4," who passed to "3," who passed to "5," etc., then the correct pattern would be:

$$\begin{array}{c} 1 \mid 2, 4, 3, 5, \dots, N \end{array} \quad [8]$$

Note that the "Z" form is not indicated. Team members can only pass on what they receive. Questions can be asked of the initiator(s) who, however, cannot adequately respond. The place where a "Z" formation is likely is between the initiator and the first recipient. Thus, the following representation is possible:

$$\begin{array}{c} 1 \mid Z \mid \end{array} \rightarrow \begin{array}{c} 2 \mid 3, 4, 5, \dots, N \end{array} \quad [9]$$

Notice, it has been stated that warning orders can be issued as fanout or as a propagation pattern. It is quite possible that both patterns can occur in combination, although this has never been

observed. Suppose the assistant receives the order from the team leader. Further suppose the assistant informs team members 3, 4, and 5 as a group, and team member 6 as an individual, and that team member 6 informs team member 7 who informs 8, etc. This can be recorded as separate patterns. The first pattern would describe the dependency between the team leader and assistant:

1 | Z | → 2 [10]

the second between the assistant and team members 3, 4, and 5 as a group and team member 6 as an individual (the fanout pattern):

2 | Z | [3, 4, 5] 6 << [11]

and the last between team members 6 and 7, and so on (the propagation pattern):

6 | 7, 8, . . . , N → [12]

Patterns [10], [11], and [12] can also be combined into one pattern:

1 | Z | → 2 Z | [3, 4, 5] 6 << 6 7, 8, . . . , N [13]

Dependency Type

Typically, warning orders are issued verbally and directly. Thus, it would be represented as CD (Communication Direct). Assuming a propagation pattern, the sketch would be recorded as:

CD
1 | 2, 3, 5, 4, 9, 8, 7, 6 [14]

Dependency Element

The content of the warning order is the dependency element. Typically, the warning is simple and straightforward (e.g., We have a mission to _____). Also, the time of the mission might be given, if known.

Dependency Purpose

The purpose of a warning order dependency is to provide instructions and information (OID); thus, the warning can be represented as:

CD
1 | 2, 3, 5, 4, 9, 8, 7, 6 [15]
OID

assuming a propagation pattern.

Issuance of Operation or Frag Order to Team Members

Variations and Patterns

Frag orders are typically issued to the team members by the team leader shortly before the mission is to start. The most common situation is for the team leader to gather the team members together as a group. Thus, a fanout pattern is appropriate to describe the situation:

1 | Z | [2, 3, 4, 5, . . . , N] << [1]

where "1" denotes the team leader, the "Z" denotes a "Z" format (only required if questions are asked by the recipient(s), the double caret (<<) denotes a fanout pattern, the brackets denote the frag order was issued to the group as a whole, and 2, 3, 4, 5, . . . , N denotes the recipients of the frag order.

One variation of this is also seen frequently. Often the frag order is issued by the assistant and not the team leader (since the team leader might be busy doing other things). Thus, the pattern would be represented as:

2 | Z | [3, 4, 5, . . . , N] << [2]

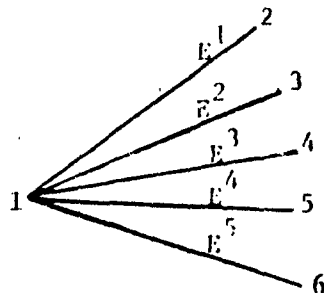
It should be noted that a "Z" format is usually needed to describe the situation, since the recipients tend to ask a lot of questions about their own individual assignments, about what to expect, etc.

It should also be mentioned that in missions, the team leader or initiator of the frag order also talks to every team member individually after the frag order is issued to verify that each team member understands his assignment. If this is observed, two patterns are required to describe the situation. The first pattern required is the issuance of the frag order itself (pattern [1]), the second pattern required is the one which describes the individual discussion between the team leader and the team members. This can be represented as a simple pattern for each team member; e.g.,

1 | Z | _____> 2
1 | Z | _____> 3
1 | Z | _____> N [3]

A fanout pattern is not appropriate because the dependency element transferred between the team leader and each individual is probably different; i.e., the discussion concerns each individual's assignment

and responsibility in the mission. As an alternative to listing each individual dependency, the outward cluster pattern can be used. In fact, the outward cluster pattern is the preferred pattern to record. The long hand version of the outward cluster pattern would be:



where "1" denotes the initiator; 2, 3, 4, and 5 denote the recipients and E^1 through E^5 denote that the dependency element between the initiator and recipients are all different. The shorthand version is as follows:

$$1 \rightarrow | Z | 2, 3, 4, \dots, N \quad [4]$$

where "1" denotes the initiator, the "Z" denotes a "Z" format (only appropriate if the individuals ask questions during the individual discussion), the single arrowhead denotes an outward cluster pattern, and 2, 3, 4, \dots , N denotes the individual recipients.

It may be elected to represent the issuance of the frag order (the fanout pattern) and the verification of individual assignments (the outward cluster pattern) as a chain of patterns; e.g.,

$$1 | Z | [2, 3, 4, \dots, N] \leftarrow 1 \rightarrow | Z | 2, 3, 4, \dots, N \quad [5]$$

It should be noted that the verification of individual assignments frequently does not occur on an individual basis. This is particularly true if the team of interest is organized into nested teams. Frequently, the team leader will verify the responsibilities of the nested team as a group. If this situation occurs, then the outward cluster pattern is still appropriate, but the group verification must be indicated instead of the individual verification. Suppose the team has one nested team composed of team members 4 through N. Further suppose all other team members have individual assignments. If the team leader verified the responsibilities of each individual (individually) and the nested team as a group, then the following representation is appropriate:

$$1 \rightarrow | Z | 2, 3 [4, 5, \dots, N] \quad [6]$$

where "1" denotes the team leader, "Z" denotes the "Z" format, the single arrowhead denotes the outward cluster pattern, the brackets indicate the nested team (whose responsibilities were verified as a group), and 2 and 3 represent the team members whose responsibilities were verified individually. An alternative representative would be:

$$1 \rightarrow | Z | 2, 3 [A] \quad [6A]$$

where the "A" denotes the nested team A, composed of team members 4 through N.

Dependency Type

Frag orders are typically issued verbally and directly. Thus, the proper code is CD (Communication Direct) which can be recorded as follows in the fanout pattern:

1 | Z | [2, 3, 4, . . . , N] ^{CD} << [7]

The verification of individual assignments, the outward cluster, is also usually performed as a verbal, direct communication (CD). Thus, the proper sketch is:

1 | Z | 2, 3 [A] ^{CD} [8]

Dependency Element

Notice two patterns are often required to describe the issuance of frag orders. The fanout pattern to represent the issuance of the order and the outward cluster pattern to verify individual assignments. Each of these has a different dependency element.

The dependency element for the issuance of the frag order is the content of the frag order, itself. The frag is a "boiled down" version of the operations order and usually contains the following information:

1. Objective of the mission.
2. Tactical approach of objective.
3. Status of equipment.
4. Status of supplies and materials.
5. Individual assignments.
6. Friendly situation.
7. Enemy situation.
8. General information and direction (e.g., standing operating procedures, meaning of signals, etc.).

The dependency element for the verification of individual assignments consists of the content of the discussion between the team leader and each individual. Thus, there are as many elements as there are individuals. To avoid recording all of these, it is appropriate to state that all the discussions, in general, were the same and concerned the individual's assignment for the mission.

Dependency Purpose

The purposes of the frag order dependency are:

1. Orders, Instructions, Directions (OID).
2. Status of Individual Activities (SIA).
3. Status of Personnel (SP).
4. Status of Supplies (SS).
5. Status of Equipment (SE).
6. Information about the Mission Environment (IME).
7. Information about the Enemy or OPFOR (IMO).

These can be recorded in the following manner:

CD

$$\frac{1 \mid Z \mid [2, 3, 4, \dots, N]}{OID, SIA, SP, SS, SE, IME, IMO} \ll [9]$$

The verification of individual assignments will typically have the following purposes:

1. Orders, Instructions, Directions (OID).
2. Status of Individual Activities (SIA).
3. Feedback or Corrective Action (FC), particularly if the individual has misunderstood his/her assignment.

These can be recorded as follows:

CD

$$1 \gg \frac{1 \mid Z \mid [2, 3, A]}{OID, SIA, FC} [10]$$

Issuance of Other Orders

Variations and Patterns

During a mission, many orders are usually issued. Soldiers are given instructions and directions to follow. Typically, these orders are issued using a simple pattern or a fanout pattern. The simple pattern is used to represent the situation where there is one initiator and one recipient:

1 —————> 2 [1]

The fanout pattern is used when there is one initiator and multiple recipients, and the dependency element transferred to each recipient is identical. Typically, the order is given to an entire group of individuals or a nested team. Thus, the most appropriate pattern is:

1 — [2, 3, 4] —<< [2]

where "1" denotes the initiator, the double caret (<<) denotes the fanout pattern, the brackets denote the order was issued to a group or a nested team, and the numbers within the brackets indicate the members of the group or nested team. An alternative to pattern [2] would be:

1 — [A] —<< [3]

where "A" denotes nested team A composed of team members 2 through 4.

In a fanout pattern after the order is issued, it may be repeated by the nested team leader. For example, in an Infantry squad, the squad leader may issue the order for the Alpha team to flank right. This is issued to every Alpha team member, in a fanout pattern, in a group. Thus sketch [3] above is appropriate. Immediately following this order from the squad leader, the Alpha team leader may repeat the order to his team. This situation can also be represented as a fanout pattern. These patterns would be recorded as:

1 — [A] —<< [4]
2 — [3, 4, 5, 6] —<<

or chained together as:

1 — [A] —<< 2 — [3, 4, 5, 6] —<< [5]

It should be noted that a "Z" format is not indicated. Typically in a tactical situation, the recipients do not have an opportunity or time to ask questions about the order. Thus, a "Z" format is not usually observed.

Although simple patterns and fanout patterns are the most commonly observed for issuing orders, observers have encountered a rather unique method in Infantry squads. This method is common to many of the missions performed by the Infantry squad. In a movement to contact mission, the squad typically is moving in a wedge formation. The point man will issue an order using a hand signal (e.g., the hand signal to stop, danger area). This order is then transferred down the wedge from one team member to another team member (all using the same hand signal). This situation can best be represented using a propagation pattern, such as:

3 | [4, 5, 6, 7] [8, 9, 10, 11] [1, 2] [6]

where the "3" denotes team member 3 (the point man), the vertical bar denotes a propagation pattern, and 4 through 12 represent the recipient team members. The brackets denote the legs of the wedge, and the sequence in which the hand signal was propagated (i.e., the signal passes from 3 to 4, 8, and 1, and is propagated in parallel thereafter).

Dependency Types

Orders issued during the mission are typically verbal and direct. Thus, the most common code would be CD (Direct Communication).

However, hand signals, smoke signals, etc. should also be suspected indicating that codes N1, N2, and N3 may be possible. N1 through N3 denote the use of signals (N1 denotes standard signals, N2 denotes team specific signals and N3 denotes mission specific signals).

Dependency Elements

The dependency elements will vary depending upon the content of the orders.

Dependency Purpose

The purpose of the dependency will vary with the content of the orders. However, the following purposes should be suspected:

1. Orders, Instructions, and Directions (OID).
2. Status of Mission Progress (SMP).

¹Often the order is directed to the Alpha team, but is also heard and understood by the Bravo team.

3. Status of Individual Activities (SIA).
4. Feedback or Corrective Action (FC).
5. Status of Personnel (SP).
6. Status of Supplies (SS).
7. Status of Equipment (SE).
8. Information about Mission Environment (IME).
9. Information about Enemy or OPFOR (IMO).

Lifting and Carrying

Variations and Patterns

A situation frequently encountered is the lifting and carrying of heavy objects by two or more team members. A convention has been adopted for recording this situation. It is viewed that lifting and carrying is both a virtual dependency (Type I) and a procedural dependency (P2). It is a Type I virtual dependency because a team or nested team of individuals are all performing the same activity and are dependent upon each other to complete the objective of the activity. It is a non-mediated procedural dependency because complete sets of individual activity are passed from one team member to another continuously throughout the activity, and there is a definite sequence. To record this situation, use the following sketch:

VI/P2 3, 4, 5, 6, 7, 8, 9 [1]

where VI denotes a virtual dependency, Type I (having a complex pattern), 3 through 9 denote the participants in the lifting and carrying and P2 denotes a non-mediated procedural dependency.

Frequently the lifting and carrying is accompanied by a supervisor, who is not involved in the actual lifting and carrying, but issues commands and cadences (e.g., "ready," "lift," "one," "two" etc.). Thus, an additional pattern would be required to describe the situation. A fanout pattern for the commands and cadences is required, plus a pattern for the actual lifting and carrying:

1 3, 4, 5, 6, 7, 8, 9 << [2]

VI/P2 3, 4, 5, 6, 7, 8, 9

These two patterns should not be chained together, since they occur simultaneously.

Dependency Type

The command cadence pattern would have type code of CD (Direct Communication). No code is needed on the lifting and carrying pattern, since the sketch itself contains the codes for virtual and procedural dependencies.

Dependency Element

The command and cadence pattern has a dependency element consistent with the commands given (e.g., "ready," "lift," "one," "two," etc.). The element of the lifting and carrying dependency is simply the lifting and carrying of the object. However, be sure to specify the object being carried; e.g.,

CD

1 3, 4, 5, 6, 7, 8, 9 <<
Element: "Ready," "Lift," cadence count

V1 3, 4, 5, 6, 7, 8, 9 (P2)
Element: Lift and carry a log (10 feet, 1 foot diameter)

Dependency Purpose

The purpose of the command cadence pattern is typically the provision of orders, instructions, and directions (OID). The purpose of the lifting dependency can involve the following:

1. Status of Individual Activity (SIA).
2. Feedback and Corrective Action (FC).
3. A stated, nonstandard purpose: "carry log to log crib site."

Loading and Unloading a Vehicle

Variations and Patterns

Three variations of the loading/unloading situation have been observed. The first involves a team or nested team assigned the responsibility to load or unload materials and supplies from a vehicle, but each individual is not given a specific assignment and all the items are portable by one person. Each individual continues to load or unload the items until all the items are unloaded or loaded. This situation can be represented by a complex pattern. In addition, the situation fits the definition of a Type II virtual dependency. Thus, the most appropriate pattern would be:

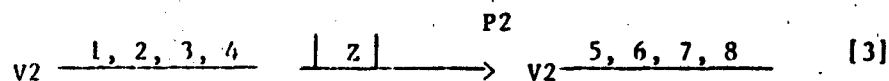
V2 1, 2, 3, 4, 5, . . . , N [1]

where V2 denotes a Type II virtual dependency and the numbers indicate the participants in the loading and unloading.

The second variation involves the loading and unloading of heavy objects; e.g., logs. Typically, in this situation, a nested team is formed at random and assigned a position on the vehicle. Another nested team is formed (at random) and is assigned a position off the vehicle. The objective is to pass the object from those on the vehicle to those off the vehicle. The dependency between the two nested teams can be represented as:



where "A" denotes the nested team on the vehicle and "B" denotes the nested team off the vehicle. The "Z" format is indicated because there may be some give and take between the two nested teams. It should be noted that the dependency between the two nested teams is not a virtual dependency. It is a non-mediated procedural dependency (P2). It should also not be forgotten that there are dependencies within each nested team. The within nested team dependencies are probably adequately described by pattern [1] in the Lifting and Carrying Section of this Appendix. The two patterns can be chained together in the following way:



where the first set of brackets denotes nested team "A," the second set of brackets indicates nested team "B," the patterns within the brackets indicate or describe the dependency within the nested teams, the "Z" denotes a "Z" format, and the arrowhead denotes a simple pattern between the two nested teams.

Dependency Type

The within nested team dependencies in pattern [3] are Type II virtual dependencies and need not be coded. The between nested team dependency is a procedural dependency (P2).

Dependency Element

The within nested team dependency has the element of transferring the object (e.g., logs) from one location to another. The between nested team dependency has an element concerning the transfer of weight between the "A" nested team and the "B" nested team.

Dependency Purpose

The within nested team dependencies have the following purposes:

1. Status of Individual Activities (SIA).
2. Status of Supplies (SS).
3. Feedback and Corrective Action (FC).

The between nested team dependency has the following purposes:

1. Status of Individual (nested teams) Activities (SIA).
2. Feedback and Corrective Action (FC).

Aligning or Directing a Vehicle

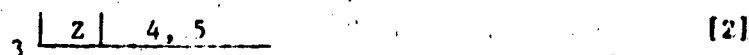
Variations and Patterns

Three variations of this situation have been observed. The first variation involves the vehicle driver and another team member. The other team member is assigned the responsibility to give hand signals to the driver, in order to position the vehicle. This pattern typically involves a "Z" format. The individual directing gives signals one at a time until the vehicle is in position. The driver reacts to each signal, and in response, the person providing the signals reacts to the driver's actions. This situation can be described by a simple pattern, since there is one initiator and one recipient. The pattern would be recorded as:



where "3" denotes the individual providing the signals, "Z" denotes the "Z" format, "4" denotes the driver, and the single arrowhead denotes a simple pattern.

A second variation was observed when vehicles without rear view mirrors were involved and the vehicle was being backed up. In this situation, a team member is positioned to the rear of the vehicle and a second team member is positioned to the side of the vehicle, but in front of the driver in the vehicle. The person to the rear of the vehicle provides hand signals to the person at the side of the vehicle, and this individual in turn relays the hand signal to the driver. The proper pattern to represent this situation would be:



where "3" denotes the individual to the rear of the vehicle, the vertical bar denotes a propagation pattern, the "Z" denotes a "Z" format, the person to the side and front of the vehicle is denoted as 4 and the driver is denoted as 5.

A third variation has also been observed frequently, but always appeared to be ineffective. This is a case where no single individual was assigned the responsibility to provide the signals, and as a result, the driver of the vehicle would be receiving signals from a group of individuals. Frequently, each individual would provide a different signal. This situation can best be represented as an inward cluster, with multiple initiators (each with perhaps a different hand signal), and one recipient--the driver.

Graphically, the variation can be depicted as:

$\overline{3, 4, 5, 6} \rightarrow 8 \quad [3]$

where 3, 4, 5, and 6 denote the position numbers, the initiators of the hand signals; the arrowhead denotes an inward cluster pattern; and 8 denotes the position number of the driver (recipient).

Dependency Type

Regardless of which pattern is observed (the simple pattern, the propagation pattern, or the inward cluster pattern), the dependency type is always N1 (standard hand signals).

Dependency Element

The dependency element consists of the hand signals issued during the alignment process. It is not necessary to list the hand signals in the sequence in which they were observed. However, it is necessary to describe each hand signal that was observed.

Dependency Purpose

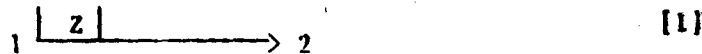
Alignment of a vehicle into a prescribed location has the following purposes:

1. Orders, Instructions, Directions (OID).
2. Status of Individual Activities (SIA).
3. Status of Equipment (Vehicle) (SE).
4. Feedback and Corrective Action (FC).

Preparing a Report

Variations and Patterns

Only two variations of this situation or mission activity have been observed. In each variation only two people or individuals are involved. In the first variation, one individual obtained the data to be recorded and verbally transmitted it to another individual who recorded it. In this variation, the data gathering was performed as a team activity with the data recorder. The form completing activity is represented by the following:



where "1" denotes the data gathering and transmission, "Z" denotes a "Z" format, "2" denotes the data recorder, and the single arrowhead denotes a simple dependency pattern. The "Z" format is indicated to represent the back and forth dialog between the two team members.

The second variation involves two individuals who arbitrarily decide to divide the labor. One individual takes part of the form to complete, and the other individual takes the remaining part. This also can be represented as a simple pattern:



The "Z" format is indicated because often the two members discuss what should be entered on the form.

Notice that patterns [1] and [2] are identical. However, the two situations are different. This difference shows up when the dependency type is recorded.

Dependency Type

Pattern [1] is typically coded as a CD (Direct Communication). Pattern [2] is coded as a non-mediated procedural product dependency (P2; since products of individual activity are exchanged), usually with a secondary CD element (i.e., P2, CD).

Dependency Element

Pattern or variation [1] has, as the dependency element, the transfer of data and information. Variation [2] has, as the dependency element, the transfer of completed sections of the form.

Dependency Purpose

The purpose of the first dependency is the transfer of data (DA). The purpose of the second dependency is the status of individual activities (SIA).

NOTE: In both variations, the actual completing of the form is an individual activity. The first variation only discusses the transfer of data. The second variation only discusses the transfer of complete sections of the form.

Providing Security

Variations and Patterns

Two variations of this situation have been observed. The most common variation involves a nested team which has been assigned the responsibility to provide security for the larger team while the larger team is engaged in another activity. Note that this is a procedural product (P2) pattern. This situation can best be represented as a fanout pattern between nested teams, in the following manner:



where "A" denotes the nested team providing security, "B" and "C" denote two nested teams of the larger team (receiving the security), and the double caret (<<) denotes a fanout pattern.

The second variation occurs in two situations. First, suppose a squad is engaged in a movement to contact mission. Each individual is providing security for himself as well as other team members. Furthermore, each individual is receiving security from the other team members. This is the classic example of a Type I virtual dependency and can be graphically represented as:



where VI denotes a Type I virtual dependency and 1 through N represent all the initiators and recipients of the security.

This variation also occurs in the nested team example. It should be noted that pattern [1] represents the dependency between the security nested team and the remaining nested teams or the larger team. It does not represent the dependency within the security nested team. Within the security nested team, each individual is providing security for himself, other nested team members, and the team at large. Pattern [1] only shows or illustrates the latter. Pattern [2], however, can be used to illustrate the former two recipients of the security activity.

For clarity, pattern [1] can be rewritten as:

P2
v1 1, 2, 3, . . . , N [B] [C] [3] <<

where the first set of brackets indicates the security nested team (nested team "A"), the pattern within the first set of brackets denotes the dependency within the security nested team, "B" and "C" denote the remaining nested teams of the larger team (and are bracketed to indicate they are nested teams), and double caret (<<) denotes a fanout pattern.

Dependency Type

Patterns [1] and [3] are non-mediated procedural dependencies (P2), while pattern [2] is a Type I virtual dependency.

Dependency Element

The dependency element for both patterns is the provision of security.

Dependency Purpose

The following purposes appear reasonable for both patterns:

1. Status of Individual/Nested Team Activities (SIA).
2. Information about the Enemy or OPFOR (IMO).

APPENDIX D
MODEL VALIDATION

APPENDIX D

MODEL VALIDATION

The purpose of this appendix is to present a brief discussion of the validation of the team organization and performance model discussed in Section 1 of this report. At the conclusion of development of the model--after four cycles of observations of teams and subsequent revisions of the model to incorporate the team phenomena observed--the model was felt to be substantially complete. The concepts included in the model were found to be able to describe the nominal and actual structural characteristics and the performance/behavioral characteristics of all of the teams and missions observed to that time.

In order to determine the extent to which the model could be judged comprehensive, complete, and conditionally general, however, a validation exercise was planned. The consistency of the model was examined by observing teams and missions that had been observed previously during model development. Descriptions of the team missions observed with the "repeat" team (Infantry rifle squads) were prepared, and the descriptions compared to previously-completed descriptions of the same team type performing both the same and different missions. Using the "repeat" team descriptions, the following characteristics of the model were identified for both the "development" team mission descriptions were the "validation" team mission descriptions:

- . Number and titles of nominal team positions
- . Existence of nominal nested teams
- . Equipment associated with nominal nested team positions
- . Number of actual team roles and role titles
- . Responsibilities assigned each actual team role
- . Equipment associated with each actual team role
- . Types of dependencies observed during mission performance
- . Dependency purposes observed during mission performance
- . Dependency patterns observed during mission performance
- . Existence of actual nested teams

Comparison were made between two missions with identical titles (movement to contact)--one from development observations, and the other from validation observations--and between two missions with different

titles, but similar overall goals: deliberate attack (development), and airmobile raid (validation). The same nominal team type (Infantry rifle squads) was observed for all missions. The development descriptions were prepared from observation of Airborne (82nd Division) squads; the validation descriptions were based on observation of Air Assaults (101st Division) squads. Different squads were used to prepare each of the four descriptions.

In all four of the missions, the squads observed had identical nominal team structure (as reported by the squad leaders); the "standard" eleven-man squad nominal structure. The structures observed each contained nominal nested teams: the Alpha and Bravo fire teams. All four teams were, however, understrength by one or two men. Observation of actual team structures adopted during the missions revealed very high degrees of similarity between the actual structures of the four teams, as well. The nominal nested team structure of all four teams was maintained as an actual structure during the missions, although in one of the validation missions (movement to contact) two machine gunners were attached to the squad being observed (the squad was point squad in a company movement to contact). These individuals were attached to the squad leader, however, rather than being incorporated in the nested team structure of the squad. Only slight variations in actual team role names were observed: one squad leader designated his fire teams as "fire" and "maneuver" teams, rather than the standard "Alpha" and "Bravo" designations.

Especially careful attention was paid to characterizing the types, purposes, and patterns of dependencies observed during these four missions and comparing the characteristics observed. Summaries of dependency types, purposes, and patterns are presented in Tables 1, 2, and 3 for all team types and missions observed during model development and validation (not just the four missions considered during the validation exercise). As these tables reflect, the dependency types observed during the four missions were identical. Since this part of the validation effort was concerned only with evaluating the completeness and consistency of the model, no frequency tabulations or other numerical analysis of dependency types (or of other dependency characteristics) was performed. Similarly, the dependency purposes identified in the four missions under consideration were identical, as were the kinds of dependency patterns observed.

At this level of analysis, the observation and comparison of descriptions of the "repeat" team missions indicated that the model was essentially completed within limits of the team types and missions observed. During the validation observations and preparation of mission descriptions for the missions observed, all characteristics of the structure, organization, or behavior of the "repeat" validation teams or missions could be accounted for by concepts of the model. It should be noted that some of the characteristics of the model were not required to describe these particular teams and missions (i.e., Type II virtual dependencies, physical product dependencies). This was deemed unimportant, as these characteristics were firmly established

TABLE 1.
DEPENDENCY TYPES OBSERVED DURING
MODEL DEVELOPMENT AND VALIDATION
BY TEAM TYPE AND MISSION

DEPENDENCY TYPES

TEAM TYPE	MISSION	CD	CI	CN	PD	P1	P2	V1	V2
4.2-in. Mortar Squad (Development)	Registration/Adjust Fire	X			X	X	X		
	Repeat Mission	X			X	X	X		
	Split Mission	X			X	X	X		
ITV Crew (Development)	Dismount TOV	X		X	X	X	X		
	Mount TOV	X		X	X	X	X		
	Simulated Fire Mission	X			X	X	X		
	Reload	X			X	X	X		
	Immediate Action	X				X	X		
	Ops Check	X			X		X		
Infantry Squad (Development)	Prepare Fighting Positions	X		X			X	X	
	Reconnaissance Patrol	X		X				X	
	Daylight Defense	X		X				X	
	Security Mission	X		X				X	
	Movement to Contact	X		X			X	X	
	Deliberate Daylight Attack	X		X				X	
	Night Attack	X		X				X	
	Obstacle Crossing	X		X			X	X	
	Body Search	X		X			X	X	
	MOUT	X		X			X	X	X
	Hasty Attack	X		X			X	X	
81-mm Mortar Squad (Development)	Registration/Adjust Fire	X			X	X	X		
	Repeat Mission	X			X	X	X		
	Traversing Fire	X			X	X	X		
	Reduced Strength (Casualties)	X			X	X	X		
81-mm Mortar Fire Direction Center (Development)	Initial Call for Fire	X					X		
	Adjust Fire	X					X		
	Split Missions	X					X		
	Reduced Strength (Casualties)	X					X		

TABLE 1. (Concluded)
DEPENDENCY TYPES OBSERVED DURING
MODEL DEVELOPMENT AND VALIDATION
BY TEAM TYPE AND MISSION

DEPENDENCY TYPES

TEAM TYPE	MISSION	CD	CI	CN	PD	P1	P2	V1	V2
Disgruntled TOW Crew (Development)	Dismount and Emplace TOW	X			X	X	X		X
	Erect Camouflage Improve Positions	X		X		X	X		X
	Simulated Fire Missions	X			X	X	X		X
	Mount TOW	X			X	X	X		X
Combat Engineer Squad (Development)	Install Triple Standard Concertina	X		X			X		X
	Install Tactical Minefield	X		X	X		X		X
	Anti-tank Trench Construction	X		X		X	X		
Assault Ribbon Bridge Platoon (Development)	Stage/Launch/Recover	X		X		X	X		X
	Construct 5-Bay Raft	X		X		X	X		X
	Rafting Operations	X		X		X	X		
	Construct Bridge	X		X		X	X		X
105-mm Fire Direction Center (Validation)	Initial Call for Fire	X					X		
	Split Missions	X					X		
	Adjust Fire	X					X		
	Reduced Strength (Casualties)	X					X		
Infantry Squad (Embedded in Platoon, Company Operations) (Validation)	Movement to Contact	X	X	X			X	X	
	Deliberate Daylight Defense	X		X			X	X	
	Raid (Airmobile)	X	X	X			X	X	

TABLE 2.
DEPENDENCY PURPOSE CATEGORIES OBSERVED DURING
MODEL DEVELOPMENT AND VALIDATION
BY TEAM TYPE AND MISSION

DEPENDENCY PURPOSE CATEGORIES*

TEAM TYPE	MISSION	OID	SM	SIA	SP	SS	SE	FC	IME	IMO	PS	DA
4.2-in. Mortar Squad (Development)	Registration/Adjust Fire	X		X			X	X				
	Repeat Mission	X		X			X	X				
	Split Mission	X		X			X	X				
ITV Crew (Development)	Dismount TOW	X	X	X			X	X				X
	Mount TOW	X	X	X			X	X				
	Simulated Fire Mission	X		X			X					X
	Reload	X		X			X					X
	Immediate Action	X		X			X					X
	Ops Check	X		X		X	X					X
Infantry Squad (Development)	Prepare Fighting Positions	X	X	X	X		X	X	X	X	X	X
	Reconnaissance Patrol	X	X	X	X		X	X	X	X	X	
	Daylight Defense	X		X	X		X	X	X	X		
	Security Mission	X		X	X		X	X	X	X		
	Movement to Contact	X	X	X	X		X	X	X	X		
	Deliberate Daylight Attack	X	X	X	X		X	X	X	X		
	Night Attack	X	X	X	X		X	X	X	X		
	Obstacle Crossing	X	X	X				X	X		X	X
	Body Search	X		X				X	X		X	
	MOUT	X	X	X				X	X		X	
	Hasty Attack	X	X	X		X	X	X	X		X	
	Registration/Adjust Fire	X		X		X	X	X				
	Repeat Mission	X		X			X	X				
81-mm Mortar Squad (Development)	Traversing Fire	X	X	X	X		X	X			X	
	Reduced Strength (Casualties)	X		X			X	X				
		X		X			X	X				

*For the meaning of purpose codes, refer to the model discussion in Section 1.

TABLE 2. (Concluded)
DEPENDENCY PURPOSE CATEGORIES OBSERVED DURING
MODEL DEVELOPMENT AND VALIDATION
BY TEAM TYPE AND MISSION

DEPENDENCY PURPOSE CATEGORIES*												
TEAM TYPE	MISSION	OID	SM	SIA	SP	SS	SE	FC	IME	IMO	PS	DA
81-mm Mortar Fire Direction Center (Development)	Initial Call for Fire	X		X					X	X		X
	Adjust Fire	X		X				X	X	X		X
	Split Missions	X	X	X				X	X	X		X
	Reduced Strength (Casualties)	X		X	X		X	X	X	X		X
Dismounted TOW Crew (Development)	Dismount and Emplace TOW	X	X	X			X	X			X	
	Erect Camouflage/Improve Positions	X	X	X			X	X				
	Simulated Fire Missions	X		X			X	X	X	X		
	Mount TOW	X		X		X	X	X			X	
Combat Engineer Squad (Development)	Install Triple Standard Concertina	X	X	X			X	X	X	X	X	
	Install Tactical Minefield	X	X	X			X	X	X	X	X	
	Antitank Trench Construction	X	X	X				X	X	X		
	Stage/Launch/Recover	X	X	X		X	X	X			X	
Assault Ribbon Bridge Platoon (Development)	Construct 5-Bay Raft	X	X				X	X	X			
	Rafting Operations	X	X				X	X				
	Construct Bridge	X	X	X		X	X	X				
	Initial Call for Fire	X		X				X	X	X		X
105-mm Fire Direction Center (Validation)	Split Missions	X	X	X				X	X	X	X	X
	Adjust Fire	X		X				X	X	X		X
	Reduced Strength (Casualties)	X	X	X	X			X	X	X		X
	Movement to Contact	X		X				X	X	X		X
Infantry Squad (Embedded in Platoon, Company Operations) (Validation)	Deliberate Daylight Defense	X		X	X	X	X	X	X	X	X	
	Raid (Airmobile)	X	X	X	X			X	X	X	X	

* For the meaning of purpose codes, refer to the model discussion in Section 1.

DEPENDENCY PATTERNS

TABLE 3.
DEPENDENCY PATTERNS OBSERVED DURING
MODEL DEVELOPMENT AND VALIDATION
BY TEAM TYPE AND MISSION

TEAM TYPE	MISSION	DEPENDENCY PATTERNS						
		Fanout	Inward Cluster	Outward Cluster	Propagative	2	Type I Virtual	Type II Virtual
4.2-in. Mortar Squad (Development)	Registration/Adjust Fire Repeat Mission Split Mission	X X X			X X X			
ITV Crew (Development)	Dismount TOW Mount TOW Simulated Fire Mission Reload Immediate Action Ops Check	X X X X X X			X X X		X X X	X
Infantry Squad (Development)	Prepare Fighting Positions Reconnaissance Patrol Daylight Defense Security Mission Movement to Contact Deliberate Daylight Attack Night Attack Obstacle Crossing Body Search MOUT Hasty Attack	X X X X X X X X X X X X X X X X	X X X X X X X X X X X X X X X X	X X X X X X X X X X X X X X X X		X X X X X X X X X X X X X X X X	X	X
81-mm Mortar Squad (Development)	Registration/Adjust Fire Repeat Mission Traversing Fire Reduced Strength (Casualties)	X X X X			X X X X			

TABLE 3. (Concluded)
DEPENDENCY PATTERNS OBSERVED DURING
MODEL DEVELOPMENT AND VALIDATION
BY TEAM TYPE AND MISSION

TABLE 3. (Continued)

DEPENDENCY PATTERNS OBSERVED DURING
MODEL DEVELOPMENT AND VALIDATION
BY TEAM TYPE AND MISSION

TEAM TYPE		MISSION		DEPENDENCY PATTERNS									
				Fanout		Inward Cluster		Outward Cluster		Z	Type I Virtual		Type II Virtual
				X	X	X	X	X	X		X	X	
81-mm Mortar Fire Direction Center (Development)	Initial Call for Fire Adjust Fire Split Missions Reduced Strength (Casualties)	X	X	X	X	X	X	X	X				
				X	X	X	X	X	X				
Dismounted TOW Crew (Development)	Dismount and Emplace TOW Erect Camouflage Improve Positions Simulated Fire Missions Mount TOW	X	X	X	X	X	X	X	X				
				X	X	X	X	X	X				
Combat Engineer Squad (Development)	Install Triple Standard Concertina Install Tactical Minefield Antitank Trench Construction	X	X	X	X	X	X	X	X				
				X	X	X	X	X	X				
Assault Ribbon Bridge Platoon (Development)	Stage/Launch/Recover Construct 5-Bay Raft Rafting Operations Construct Bridge	X	X	X	X	X	X	X	X				
				X	X	X	X	X	X				
105-mm Fire Direction Center (Validation)	Initial Call for Fire Split Missions Adjust Fire Reduced Strength (Casualties)	X	X	X	X	X	X	X	X				
				X	X	X	X	X	X				
Infantry Squad (Embedded in Platoon, Company Operations) (Validation)	Movement to Contact Deliberate Daylight Defense Raid (Airmobile)	X	X	X	X	X	X	X	X				
				X	X	X	X	X	X				

during model development, and their absence in the particular missions observed was predicted from observations made during model development.

The second aspect of the model validation exercise was directed toward establishing (in a limited way) the generality and external validity of the model. To attempt to verify model generality, a team type which had not previously been observed (Field Artillery Fire Direction Center - FART'Y FDC) was observed. While the FART'Y FDC is similar in concept to the Infantry mortar FDCs observed during model development, the nominal structure of the FART'Y FDC is somewhat different, as are the details of procedures used in the FDC and the number of gun tubes controlled.

Four kinds of missions were observed in an FART'Y FDC: initial call for fire, adjust fire, repeat missions, and split missions (some gun tubes firing at one target, the remainder of the tubes at a different target). In addition to observing and describing the missions, the nominal structure of the team was identified, as were the actual structures for each of the missions observed. These data were used to prepare team structure and mission descriptions, using the concepts of the model.

The nominal and actual team structure aspects of the model easily accounted for the organizational and structural characteristics of the FART'Y FDC. Identifying and naming team positions and roles, and the equipment and responsibilities associated with each was very simple, since this team type is small (seven positions), and (within the FDC) there is no movement. Since the team was observed at mealtime (0630), the actual team structures were always understrength (people rotated to the mess tent by ones or twos), even though the team was at full strength. Describing the various shifts of roles and responsibilities was not a problem for the model, however.

The performance characteristics of the missions observed were also described completely by model concepts (see Tables 1, 2 and 3). While the types, purposes, and patterns of dependencies that were observed were limited relative to the scope of the model as a whole (i.e., only procedural and communicative-verbal dependencies occurred), no new concepts or modifications of concepts were required to describe the mission performance of the FART'Y FDC missions.

The objectives of the model validation effort were achieved completely by the observation and description of team missions discussed above. Both the consistency of description of different teams performing similar or identical missions at different times and locations ("repeat" observations), and the external validity ("new team type" observations) of the model were confirmed by this effort. It must be noted, however, that the overall generality of the model remains unconfirmed. The model has thus far been applied only to a limited variety of military teams and missions. Although the model appears adequate to account for a wide variety of teams and mission (tasks) outside the teams and missions observed in this effort, and has

proven able to deal with hypothetical team behaviors in analyzing artificial scenarios, the generality and external validity of model concepts will be established only after wider application of the model and its concepts.

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APPENDIX E

DEVELOPMENT AND VALIDATION OF THE DESCRIPTION METHOD

APPENDIX E

DEVELOPMENT AND VALIDATION OF THE DESCRIPTION METHOD

Introduction

A previous section of this report presented the final version of the Description Method. That discussion did not describe how the Description Method was developed and validated. The purpose of this section is to describe the development of the Description Method and to present the results of the validation study conducted on the Description Method.

Background Information

Very early in the project, a set of objectives were developed for the Description Method. It was this set of objectives that guided the development of the method. These objectives were:

1. The Description Method had to flow logically from the model of team performance and behavior. The model of team performance and behavior had to identify those factors or dimensions which constituted team performance and behavior. Thus, one of the objectives of the Description Method was to develop procedures for describing those factors and dimensions of team performance and behavior that the model identified as being critical and important.
2. The application of the Description Method on a specific team type and a specific team mission had to generate usable team and team mission descriptions. Usable was defined to mean useful in identifying team training requirements and measures of team performance.
3. The Description Method had to not only contain recording forms which constituted the team and team mission descriptions, but it also had to contain a set of procedures for generating the data or information which was to be entered on the forms (the descriptions).
4. The Description Method had to be applicable to the wide variety of teams encountered in the Army. In addition, it had to be applicable to the wide variety of missions performed by Army teams.

5. The Description Method had to be as prescriptive as possible, since it was anticipated that the method would eventually be applied by military personnel (e.g., training developers).

The attainment of these objectives was not all scheduled for the first year of the project. For example, the attainment of Objective 2 could not be assessed in the first year of the project, since the development of the training requirements identification procedure and the development of the procedure to identify measures of team performance were not scheduled for completion until the second and third years of the project. Thus, it is impossible during the first year to determine if the Description Method generated descriptions which were useful in identifying team training requirements and measures of team performance. Similarly, the attainment of Objective 5 could not be assessed at the end of the first year. During the first year of the project, military personnel were not scheduled to apply to the Description Method. Only the project staff would have an opportunity to apply the method during the first year.

The attainment of Objectives 1 and 4 could only be moderately assessed at the end of the first year. Notice that both of these objectives concern the validity of the descriptions generated by the Description Method. The Description Method can only be as valid as the model of team performance and behavior. If the model is applicable to the wide variety of Army teams and missions, then the Description Method would also be applicable. If the model correctly identifies the most important and critical factors and dimensions of teams and team behavior, then the Description Method would also. This tautology exists because of the way the Description Method was developed. The Description Method was derived directly from the model. It was not empirically derived. Thus to a large extent, the validity of the Description Method is extremely dependent upon the validity of the model. In addition, the Description Method was only applied to one team type during the validation exercise.

By the process of elimination, Objective 3 became the major focus of the first year's effort with respect to the Description Method. Basically, the first year concentrated on:

1. Developing recording forms which would constitute the descriptions of teams and team missions.
2. Developing procedures to generate the data or information which would be entered in the recording forms.

Overview of Development Process

The Description Method was developed in three relatively separate and distinct stages. These were:

1. The Primitive Description Method. During the development of the model of team performance and behavior, a very primitive Description Method was developed. The purpose of the primitive method was solely to facilitate the development of the model. Although the primitive method was the forerunner of the final Description method, it was not really designed to satisfy the stated objectives.
2. Preliminary Description Method. After the model of team performance and behavior was validated, a preliminary Description Method was developed. This preliminary method was derived directly from the model and was systematically designed to satisfy the stated objectives of the Description Method. It was this preliminary method that was validated.
3. Final Version of the Description Method. After the preliminary method was validated, it was revised and modified to become the final version.¹

The developmental activities that occurred in each of these phases or stages are discussed in detail below.

The Primitive Description Method

Originally the Description Method was not scheduled for development until after the theoretical model of team performance and behavior was built and validated. However, during the model development activity, it became clear that some sort of recording forms would be needed. The model was developed by observing actual teams performing actual missions. In order to refine the concepts in the model and to identify new concepts, it was necessary to record the information obtained during these observations. To facilitate the development of the model, a set of extremely primitive recording forms were developed. These primitive forms were designed with the following characteristics in mind:

¹Final version refers to the final version developed at the end of the first year of the effort. In a sense, this version should not be considered the absolute final version, since it is expected that the second and third years of the project will require modification and additions to the method.

1. The forms would only be used by the project staff. Thus, they did not need to be sophisticated or procedural.
2. The set of forms did not have to be complete or comprehensive. It was never intended that a set of forms be completed for each observation during the model development activity. The intent was not to describe each observation in detail; the intent was to describe only those segments or parts of the observation which might have impacted upon the refinement of an existing team and team behavior concept or in the identification of a "new" concept; i.e., the forms were only viewed as a mechanism to describe something not previously observed which would likely lead to concept refinements.
3. The forms were geared to the observation format of collecting data. No attempt was made to worry about alternative ways of generating the data to be recorded; i.e., primitive method was not concerned about how the data specified on the forms should be generated.

The Primitive Description Method evolved as the model itself evolved, but the relationship was an inverse relationship. As the concepts of the model became clearer and clearer, the need for a more systematic primitive Description Method decreased; i.e., as the model builders became more familiar with each concept, it was easier to identify and thus, easier to record incidents which would impact upon the model. Thus, the primitive forms were used less and less until finally the primitive forms were entirely replaced by briefly written narratives. The narratives concentrated on describing observed team mission activities which had the potential to refine the concepts contained in the model. This was not considered harmful or detrimental. It should be remembered that the primary purpose of the primitive Description Method was to facilitate the model development activity and not to advance the state of the Description Method.

The Primitive Description Method contained the following recording forms:

1. Actual and nominal team structure recording forms. These forms were designed to record the actual team structure, as well as describe how the actual team structure was different from the nominal team structure. This form was infrequently used during the model development process, simply because the concepts associated with the actual team structure and the nominal team structure were quickly confirmed (and/or refined).
2. An equipment list recording form. This form was also infrequently employed during the model observation phase of the project, simply because the concepts of the model in this area were relatively straightforward.

3. A situational map recording form. This recording form had a high frequency of use during the initial stages of model development. It was not particularly related to any given concept in the model, but it did provide the project staff a useful vehicle for conveying the overall intent of the observed mission. These situational maps were quite frequently used during staff meetings, when concepts were being discussed and refined.

4. A primitive team mission activities recording form. This form was designed to capture either the whole mission or certain segments of the mission activities. The form consisted of ten columns (one column was devoted to each performer). Below the column headings were 1/4 inch by 1/4 inch blocks or boxes. An "X" was placed in the box of the performer who initiated the dependencies being recorded. Lines were drawn from the box with the "X" to the recipients of the dependency. The vertical dimensions of the form indicated the relative time between dependencies or individual actions. The form also contained a comments column for each row of boxes (each row described a dependency). The comments column was reserved for recording the dependency element of the dependency recorded in the row.

This form was frequently used in the early observation to record most, if not all, the observed dependencies. As the dependency concepts were further reviewed, the form was used less and less.

This form turned out to be very useful to the model development activities. In fact, it was this form which led to the concept of dependency patterns. It was noticed very early during the observation phase that the boxes tended to form patterns and the some patterns tended to be repeatedly observed. As the observation phase progressed, the project staff tended to record patterns rather than using the forms.

Although the primitive Description Method was used sparingly (e.g., only used when it was necessary to describe a set of team activities which had the potential to affect the model), its limited application resulted in some useful lessons learned. The lessons learned can be grouped into two categories. Lessons were learned about the recording forms, and lessons were learned about the observation technique of collecting data; i.e., techniques for generating the data to be entered in the forms. First, the lessons learned about the recording forms:

1. The recording forms comprising the primitive Description Method appeared to be applicable to a wide variety of team and team missions. At least it appeared applicable for

those team and team missions which were observed during the model building activity.

2. The primitive mission activities recording form, although easy to complete, was difficult to interpret and read; i.e., individuals who did not participate in the observation of the mission found it difficult to review the form and capture the flavor of the mission. The project staff felt it would have been difficult to use the completed form to identify team training requirements and measures of team performance. The form required recording too little information about the mission, mission activities, and individual activities. The form would need to be revised during the development of the Description Method.
3. The forms were reasonable devices for recording observed activities, but they could not be used during the observation in a field environment. They were paper and pencil devices, thus could not be manipulated in adverse environments (extreme temperatures, windy conditions, precipitation, etc.).
4. To complete the forms, the preparer had to be familiar with the concepts contained in the model of team performance and behavior. The forms were not stand-alone recording devices. It should be pointed out that there were no instructions developed for completing the forms of the primitive Description Method. It was quickly realized that instructions would be needed for the final version. Furthermore, it was realized that the instructions could never really be made very prescriptive, particularly for completing the team mission activities recording form.

Dependencies occur differently within each mission. Thus, the procedures for completing the form could not be made very prescriptive. It was at this point in the project that the staff started to search for some guidance which could be given to the end-users of the method. It was realized that specific procedures or instructions could be developed for recording any given dependency or team activity, but such specific instructions could not be given for completing the entire form, since the missions to be described would vary considerably.

The observation format resulted in the following lessons learned:

1. Since the forms could not be used in the field environment while actually conducting the observation, some other observation recording method or technique was required. The alternate technique could be used to record the observations, and from the observation data, the recording forms of the primitive Description Method could then be

completed. The following two alternative observation recording methods or techniques were tried during the very early stages:

- a. Videotape.
- b. Audiotape.

Videotape was cumbersome for some missions, particularly those missions where the team was required to move rapidly through the woods or other difficult terrain. In addition, the videotape equipment required at least two operators. Furthermore, we experienced many equipment malfunctions due to the environment (rough terrain, dust, precipitation, extreme temperatures, etc.).

Audiotape appeared to work the best. Hand held tape recorders could easily be obtained and were extremely transportable and reliable. They could also be easily protected from adverse environmental conditions.

2. Some team missions could not be easily observed by one observer. During the model phase, there were at least two observers per mission. It was determined that at least two observers would be required under the following conditions:
 - a. When the team was larger (e.g., greater than ten team members).
 - b. When the team was organized into nested teams, and the nested teams performed concurrently. This was particularly true when the nested teams performed in physically different locations.
 - c. When the set of activities performed by the nested team or team(s) were not repetitive; i.e., when the various nested teams were not all doing the same thing or performing the same function (regardless of whether the nested teams were located physically close to each other or not).
3. The observation format would only work if the observers knew what to look for; i.e., could recognize a team activity or dependency. The primitive Description Method contained no guidelines concerning what to look for. The final Description Method had to rectify this problem. It had to provide some guidance concerning how to identify team behaviors, activities, and dependencies.
4. The observation format required considerable pre-planning. Arrangements had to be made to observe specific missions. It was realized that conducting observations takes a long

time. Some of the observed missions involved a lapsed time of six hours or more. Furthermore, there was some downtime, time spent waiting for the team to get started.

These lessons learned contributed to the final design of the Description Method.

Preliminary Description Method

After the model of team performance and behavior was judged relatively stable (and verified), a second version of the Description Method was developed. This preliminary Description Method was derived directly from the model and the primitive Description Method. The preliminary Description Method was primarily designed to serve as a method which could be verified or validated. It was labeled a preliminary method because it was expected that the method would be considerably revised after the validation study.

Before describing the validation study and results, it is perhaps reasonable to describe the factors which influenced the development of the preliminary method:

1. The preliminary Description Method was designed to be used only by the project staff. It was not designed to be an exportable method. Thus, the preliminary method contained only the necessary recording forms and minimum directions for completing those forms. The instructions were written for the project staff, who were familiar with the model, and not for military personnel or other researchers.
2. The preliminary Description Method concentrated on identifying the data items that had to be included on the recording forms. No attention was given as to how the data entered on the forms should be generated. For example, the preliminary Description Method did not provide guidance on how to identify team behaviors, activities, or dependencies; only how to record them once they were identified. This was considered acceptable for two reasons:
 - a. The validation study was primarily designed to determine how the data entered on the forms should be generated. The method used to generate the data would influence the instructions given to the end-users.
 - b. Only the project staff would be using the method, and they had considerable experience in identifying dependencies by developing the model.

3. The preliminary Description Method only contained procedures for describing a given team type and a given mission. That is, the method did not contain procedures for selecting the team type to be described or for selecting those team missions which should be described. The sampling problem was totally avoided by the preliminary method for several reasons:

- a. The interest was in having recording forms which would work (i.e., the sampling problem was considered a secondary issue which would not influence the design of the recording forms).
- b. Any sampling procedure which would have been designed had to consider how the completed recording forms would be used to develop team training and identify measures of team performance. At this point in the project, the project staff only had a few ideas what the training requirements identification process would look like. Thus, it was considered wise to postpone developing a sampling procedure for the preliminary Description Method.

Given these intentions, the preliminary Description Method was developed in the following manner:

1. The model that existed at the time was divided into its components (e.g., General Team Type Information, Nominal Team Structure Information, Actual Team Structure Information, and Specific Mission Information).
2. The project staff met in a brainstorming session and listed all the data items that needed to be collected for each model component.
3. The identified data items were organized in an apparent systematic order, as well as rephrased. The reorganized data items were then reviewed by the project staff.
4. After some modification of the data items, the recording forms were developed. The recording forms were reviewed by each senior project staff member. They were reviewed for accuracy and completeness.
5. For each form, a set of instructions was developed. Again, the directions did not include how the data was to be generated, only recorded. In fact, the staff attempted to guarantee that the forms were agnostic toward any given method of data collection, since the validation exercise required collecting data from three different sources.

The preliminary Description Method contained the following recording forms:

1. A Team Mission Listing.
2. Nominal Team Structure Recording Form.
3. Nominal Team Structure Organizational Chart Recording Form.
4. Mission Description Recording Form.
5. A Mission Typographical Map Recording Form.
6. An Actual Team Structure Recording Form.
7. An Actual Team Structure Organizational Chart Recording Form.
8. An Actual Team Structure Deviation Report.
9. Team Member Mission Functions Recording Form.
10. A Mission Activities Description Recording Form.

In addition, the preliminary Description Method made provisions for generating a narrative of each mission. A description of each of the forms and the format for these narratives are provided in an interim report, and as such, will not be described here.

The preliminary method was then reviewed by the Technical Monitor. Both the forms and the instructions for completing the forms were reviewed, and the method was approved (i.e., approval was given to proceed with the validation exercise).

Validation Plan

The validation exercise had three primary objectives. These were:

1. To determine if two or more independent preparers could generate similar completed recording forms (team type and team mission descriptions) for the same team type and the same team mission, using the same sources, separately.
2. To determine the similarities and differences of descriptions generated from three sources (military documentation, SME interviews, and observations).
3. To determine the problems associated with generating information from the three primary sources.

Basically, the validation plan was simple and straightforward. A team type would be selected along with specific missions to be described. The recording form contained in the preliminary Description Method would be completed by at least two senior project staff members (working independently) using the three identified sources, separately. That is, first descriptions would be generated using documentation. The descriptions generated by the two independent preparers would then be compared, and the differences and similarities highlighted. The two independent sets of descriptions would then be consolidated into one set of descriptions which would represent the team and team mission descriptions generated from documentation. Next the same two independent preparers would generate descriptions for the same team type and same missions using the SME interview technique. The two sets of descriptions generated by the preparers would then be compared, and the differences and similarities highlighted. One set of descriptions representing what can be accomplished from SME interviews would then be generated. This set would be compared to the set generated from documentation alone. The process was then basically repeated for the descriptions generated from observation. This approach accommodated the reliability issue; it would provide information concerning whether two independent preparers could generate similar descriptions using each of the sources. It also accommodated the other objectives since it would be possible to determine if the descriptions generated from the three sources were, in fact, different. Furthermore, the approach would highlight the problems associated with using each source.

It was determined that the target team type for the validation effort would be Combat Engineers, mechanized (both squads and platoons). Combat Engineers were selected for several reasons. First, they could be made available for SME interviews and observations. Second, on the surface Combat Engineers appeared to perform a wide variety of team missions (i.e., the team missions did not appear to be repetitive or similar). For example, installing tactical minefield appeared to involve different team behaviors than preparing a target folder. This would permit some assessment of how well the preliminary Description Method could be applied to a wide variety of team missions.

Since the preliminary Description Method did not contain procedures for sampling the missions to be described, the Technical Monitor (with the assistance of FORSCOM personnel, SMEs, and the project staff) arbitrarily selected the missions to be described. The criteria used in this process were:

1. Team mission variability; i.e., the selected mission had to be different with respect to suspected team behavior in order to determine if the forms were appropriate for a wide variety of the missions.
2. Expectancy of observation; i.e., the selected missions had to be observable; one which might be practiced in a normal field exercise.

3. Mission length; i.e., there was interest in selecting mission which would take no longer than eight hours to complete or observe.
4. Combat influence; i.e., the selected missions had to be ones which would normally be performed in combat, since it was felt that the description techniques would eventually be used to describe such missions.

Discussions with SMEs revealed two Major Mission Areas which were good candidates: Mobility and Countermobility. This was sufficient for our purposes, since no attempt was being made to select a representative sample of mission or mission areas; i.e., the descriptions generated from the application of the preliminary Description Method were not going to be used to identify team training requirements. Thus, a rigorous or systematic sample was not required.

The following missions within the Mobility Mission Area were selected, according to the established criteria:

1. Clearing a Log Crib Obstacle.
2. Breaching a Minefield.

The following missions from Countermobility were also selected, according to the established criteria:

3. Constructing a Log Crib.
4. Preparing a Target Folder.
5. Installing a Tactical Minefield.

It was initially planned that the same five missions would be used throughout the validation study; i.e., the same five missions would be described using documentation, SME interviews, and observation. However, this was not the case. The list of missions was somewhat altered during the validation exercise. Alterations were needed in the list because it was difficult early in the validation effort to precisely determine which missions would actually be observed. Our approach was to mitigate the demand on FORSCOM field units by observing missions which would be practical in a normal field exercise. The field exercise was in the process of being prepared when the initial list of missions was selected. As time progressed, the field exercise changed, and the initial list had to be altered immediately proceeding the SME interview phase of the validation exercise. The missions described at each phase of the validation effort are reported in Table 1.

Table 1

Missions Described by Source

Mission	Source		
	Documentation	Interview	Observation
Clearing Log Crib	X	X	
Breaching Minefield	X		
Constructing Log Crib	X	X	X
Preparing a Target Folder	X	X	X
Installing at Tactical Minefield	X	X	X
Constructing a Barbed Wire Entanglement		X	
Reconnaissance of Bridge		X	X
Bridge Demolition			X
Installing a Point Minefield			X

It should be noted that only three missions were common to all three sources (Constructing a Log Crib, Preparing a Target Folder, Installing a Tactical Minefield). It was discovered during the observation phases that Preparing a Target Folder was more of an individual activity than a team activity. Thus, only two mission descriptions could be compared across all three sources. It should also be noted that four missions were described by only one of the sources, meaning that comparisons across sources would not be possible on these missions. However, two missions were described by at least two sources, permitting some degree comparison between documentation and SME interviews for one mission (Clearing a Log Crib), and a comparison between SME interviews and observation for the other mission (Reconnaissance of a Bridge). In total, very few comparisons could actually be made.

The same two individuals were involved in all three phases of the validation effort. During the observation phase, a third individual was added. A third observer was added in order to determine if a naive observer could use the preliminary Description Method. The observer was naive with respect to the missions, but not naive with respect to the preliminary Description Method. It was thought that by adding this third observer, it would be possible to assess the effect of participating in the documentation review and SME interview process (i.e., to isolate the kind of information that would be added or deleted by an observer who did not know anything about the missions being described).

Introduction to Validation Results

For clarity, the results of the validation effort are presented in three separate sections. It should be recalled that the validation effort had three primary objectives (reliability between preparers, the similarity or differences between the descriptions generated by the three sources, and the problems encountered in using each source). There is one section devoted to each of these objectives.

Consistency Between Preparers

No statistical tests or procedures were used to determine the degree of consistency (or agreement) between the independent preparers. The preparers reviewed each others descriptions and noted areas of agreement and disagreement. Areas of consistency (and/or inconsistency) were further clarified when the two dependent preparers generated the consolidated descriptions. The consolidated descriptions were generated by collapsing (or expanding) the descriptions generated by the preparers into a single description for each team type and each mission by source.

To report the results of this part of the validation effort, a series of tables are presented. The tables highlight areas of consistency and inconsistency between the preparers for each source. There is one table for each of the three sources that were used. Areas of consistency or inconsistency are reported as data items (e.g., existence of dependencies, dependency elements, nominal team position titles, size of nominal team, etc.). It should be noted that the data items fall into three major categories (data items describing the nominal team, data items describing the actual team, and data items describing the mission and team behaviors). The labels of the data items typically indicate its membership in one of the three categories. It should also be mentioned that the tables present areas of consistency and inconsistency collapsed across the various missions and team types described during the validation exercise; i.e., the tables are agnostic toward each mission and team type.

Table 2 presents the areas of consistency and inconsistency between the two independent preparers when military documentation was used as the primary source. Table 3 presents the same information when SME interviews were used as the primary source for preparing the descriptions, and Table 4 presents the areas of agreement and disagreement when direct observation was used as the primary source.

A brief discussion of the results reported in Tables 2, 3, and 4 is appropriate. It should be noted that the degree of consistency between independent preparers varied by source. In general, the least attractive degree of consistency occurred when SME interviews were used as the primary source. The highest degree of consistency occurred when direct observation was employed. These results raise a critical issue.

Table 2

Consistency Between Independent Preparers Using Documentation

Areas of General Agreement	Areas of General Disagreement	Areas Which Could Not Be Judged
<p>Mission Listing</p> <p>Nominal Team Position Titles</p> <p>Number of Nominal Team Members</p> <p>MOS of Position Title</p> <p>Mission Goal</p> <p>General Mission Procedures</p> <p>Situational Map</p> <p>Existence of Nested Teams</p> <p>Function of Nested Teams</p> <p>General Sequence of Mission Activities</p>	<p>Nominal Team Organizational Structure</p> <p>Equipment Used by Team</p> <p>Equipment Assigned to Team Members</p> <p>Assignment of Team Members to Functions</p> <p>Size of Nested Teams</p> <p>Dependency Initiators</p> <p>Dependency Recipients</p> <p>Dependency Patterns</p> <p>Dependency Purpose</p> <p>Dependencies Between Nested Teams (of those identified)</p> <p>Individual Activities Preceding Dependency</p> <p>Existence of Dependencies</p> <p>Individual Activities Following Dependency</p> <p>Dependency Elements</p> <p>Need for Support Services</p> <p>Dependency Types</p>	<p>Mission Environmental Factors</p> <p>Conditions Influencing Mission Performance</p> <p>Actual Team Structure</p> <p>Actual Team Organizational Chart</p> <p>Actual Team Size</p> <p>Assignment of Equipment to Actual Team Members</p> <p>Existence of Actual Team Nested Teams</p> <p>Size of Actual Team Nested Teams</p>

Table 3

Consistency Between Independent Preparers Using S/E Interviews

Areas of General Agreement	Areas of General Disagreement	Areas Which Could Not be Judged
Mission Listing (although some variability)	Number of Nominal Team Members	Mission Environmental Factors
Nominal Team Position Titles	Equipment Used by Nominal Team	Conditions Influencing Mission Performance
Situational Map (generally similar for movement of troops)	Assignment of Equipment to Nominal Team Members	Actual Team Structure
MOS of Position Title	Mission Goal	Actual Team Organizational Chart
	General Mission Procedures	Actual Team Size
	Existence of Nested Teams	Assignment of Equipment to Actual Team Members
	Functions of Nested Teams	Existence of Actual Team Nested Teams
	Size of Nested Teams	Size of Actual Team Nested Teams
	Dependencies Between Nested Teams	
	Existence of Dependencies	
	Dependency Elements	
	General Sequence of Mission Activities	
	Dependency Initiators	
	Dependency Recipients	

Table 3 (cont'd)
Consistency Between Independent Preparers Using S/E Interviews

Areas of General Agreement	Areas of General Disagreement	Areas which Could Not be Judged
	<p>Dependency Patterns</p> <p>Dependency Purposes</p> <p>Individual Activities Preceding Dependencies</p> <p>Individual Activities Following Dependencies</p> <p>Need for Support Services</p> <p>Function of Team Members to Functions</p>	

Table 4

Consistency Between Two Independent Observers Who Participated in Other Phases of Validation Efforts

Areas of General Agreement	Areas of General Disagreement	Areas Which Could Not be Judged
<p>Actual Team Position Titles</p> <p>MOS of Position Title</p> <p>Mission Goal</p> <p>Equipment Used by Actual Team</p> <p>Equipment Assigned to Actual Team Members</p> <p>Assignment of Team Members to Functions</p> <p>Mission Environmental Factors</p> <p>Conditions Influencing Mission Performance</p> <p>Actual Team Structure</p> <p>Actual Team Organizational Chart</p> <p>Actual Team Size</p> <p>Existence of Actual Nested Teams</p> <p>Size of Actual Nested Team Members</p> <p>Situational Map</p> <p>Functions of Actual Nested Teams</p>	<p>Dependency Purposes</p>	<p>Mission Listing</p> <p>Nominal Team Position Titles</p> <p>Number of Nominal Team Members</p> <p>Nominal Team Organizational Chart</p> <p>Assignment of Equipment to Nominal Team Members</p> <p>Existence of Nominal Team Nested Teams</p>

Table 4 (cont'd)

Consistency Between Two Independent Observers Who Participated in Other Phases of Validation Efforts

Areas of General Agreement	Areas of General Disagreement	Areas Which Could Not be Judged
<p>Dependencies Between Actual Nested Teams</p> <p>Existence of Dependencies</p> <p>General Mission Procedures</p> <p>General Sequence of Mission Activities</p> <p>Dependency Elements</p> <p>Dependency Types</p> <p>Dependency Initiators</p> <p>Dependency Recipients</p> <p>Dependency Patterns</p> <p>Individual Activities Preceding Dependency</p> <p>Individual Activities Following Dependency</p> <p>Support Required</p>		

Do the results indicate that preparers could not reliably apply the method, or do the results indicate that the sources vary in their ability to provide the necessary information; i.e., was it the sources which caused the preparers to generate descriptions which appeared similar or dissimilar? To answer this question, the following must be recalled:

1. The two preparers interviewed different SMEs.² The differences in the descriptions appeared to be due to the different opinions (and/or judgments) the SMEs had about the team type and the missions and not due to how the preparers applied the method.³
2. The two preparers used approximately the same military documentation. However, the documentation was frequently incomplete causing the preparers to make many inferences and assumptions (e.g., as to who initiated a dependency, who received the dependency, etc.). Different assumptions caused the preparers to generate different descriptions.
3. During the observation phase, the two preparers observed the same actual team performing the same missions at the same time (i.e., the missions were not repeated for each observer). Because both preparers were observing the same events their descriptions looked remarkably similar.

Thus, it would appear that given a fixed set of inputs (like in direct observation), two independent preparers can reliably apply the method. In the SME interview and the military documentation cases, the reasons for the inconsistencies appear to be the inconsistencies in the sources and not in the way the preparers applied the method. If SMEs give different inputs, then it makes sense that the resulting descriptions would be different, regardless of the reliability of the preparers to apply the method. This same rationale applies to using documentation. If preparers make different assumptions while reading the documentation, then their descriptions would be different.

Tables 2, 3, and 4 also indicate another useful property. Notice that the areas of agreement and disagreement vary by major data item category. For example:

1. Documentation appears to be a reliable source for generating data items concerning the nominal teams; i.e.,

²It was considered unreasonable to duplicate interviews with the same SME. The SMEs volunteered their time and would have perceived the exercise as being unnecessary.

³When the consolidation effort was conducted, the preparers tended to agree that the other preparer recorded the obtained information correctly, given what the SME has said.

preparers do not have to make assumptions from the documentation when reading about the nominal teams. On the other hand, documentation is not a reliable source for generating team behavior information. Preparers must make too many inferences and assumptions to reliably identify dependencies, dependency initiators, and recipients, etc.

2. Direct observation is most suited to gathering reliable data concerning team behaviors and actual team structures, but is not particularly suited to generating information about the nominal team structure (e.g., existence of nominal team nested teams, etc.).
3. SMEs are too variable to use as a reliable source for either nominal team information or for team behavior information.

One other point needs to be made concerning the consistency between independent preparers. During the observation phase of the validation exercise, a mission naive observer participated in the observations. The naive observer was familiar with both the model and the method, but was not familiar with the content and procedures of the observed missions; i.e., he did not read about the missions or discuss the missions with SMEs. The descriptions prepared by the naive observer looked different than those prepared by the two preparers who participated in the review of military documentation and the SME interviews. In general, there was more agreement between the two independent preparers than between the naive observer and either of the two independent preparers. It can therefore be concluded that reliability between preparers can be increased if the preparers understand something about the mission to be observed (particularly the general procedures of the mission).

It should be mentioned that the degree of agreement between independent preparers cannot be interpreted as a statement of accuracy. Just because two independent preparers generated similar descriptions when using direct observation, does not necessarily mean that both preparer's descriptions are representative or accurate. It only means they tended to agree to record events in the same manner. It is possible that the preparers were reliably recording inaccurate information.

In general, the following statements can be made concerning the degree of consistency between preparers:

1. Independent preparers can generate highly consistent descriptions if the input source is "fixed" (i.e., non-variable).

2. Independent preparers generate dissimilar descriptions when using documentation and SME interviews as the primary source of data or information.
3. The degree of consistency during observation is enhanced if the preparers become familiar with the missions before conducting the observations.

Consistency Between Sources

As part of the validation effort, it was necessary to determine if the three sources would generate similar descriptions. To mitigate the differences between preparers, after the descriptions were prepared from each source, the preparers would consolidate their descriptions to produce a set of descriptions representative of the source. It was these consolidated descriptions which were compared to assess the differences between the three sources. Again, no statistical procedures were performed to determine the degree of similarity or difference between the consolidated sets of descriptions. The sets of descriptions generated from each source were logically analyzed to determine general areas of consistency or inconsistency. While making this logical comparison, it was quickly discovered that blanket statements could not be made. For some missions, there was remarkable similarities in the descriptions, for other missions there was considerable differences between the generated descriptions. For example, the descriptions generated for Installing a Tactical Minefield appeared remarkably similar. There was agreement between the sources on:

1. Existence of nested teams.
2. Function of nested teams.
3. Function of individual team member within nested teams.
4. Dependencies between nested teams.
5. Existence of dependencies.
6. Dependency types.
7. Dependency elements.
8. Equipment used by nested teams (and some agreement on assignment of equipment to individual team members).
9. Mission goal.
10. General mission procedures.
11. Situations map.
12. Sequence of mission activities.

This high degree of agreement between the three sources can be attributed to the following factors:

1. The documentation available for Installing a Tactical Minefield was clear and relatively complete.
2. SMEs tended to use the same documentation during the interview as used by the preparers during the documentation phase.
3. The observed teams tended to follow the documentation when performing the mission. In fact, the observers reported seeing the team leaders using the same documentation material.

On the other hand, there was very little consistency between the three sources for the other missions.

These results seem to indicate that descriptions can be generated from all three sources with some degree of consistency (providing that the documentation is clear and complete, the mission procedures are relatively prescriptive [as for the minefield and bridge reconnaissance], SMEs are experienced team members and know what the documentation prescribes, and actual teams perform the mission as it is prescribed in the documentation). This is not to say that the description would be accurate and identical. There is some variability among SMEs, and there is also variability concerning how actual teams perform the missions of interest. In fact, there were some subtle differences between the descriptions generated from the three sources, even though the descriptions in general appeared similar. Let's briefly discuss these differences:

1. The descriptions generated from observations are much more complete than those generated either from SME interviews or documentation. SME generated descriptions are, in general, more complete than those generated from documentation.
2. Descriptions generated from observation tend to contain more dependencies. In addition, they contain more information to clarify and modify each dependency (i.e., observation generates more information about each dependency permitting the observer to classify the dependency type, expand upon the dependency element, identify the dependency purposes, etc.). It is much easier to ascertain this information from observation than SME interviews or documentation.

Dependency patterns are a particular problem. Many patterns can be hypothesized from the documentation. In addition, SMEs tend to give a specific pattern, which may or may not be observed. The only patterns that one can put

any faith in are those patterns actually observed (at least the preparer is certain that the observed pattern does occur in the field). Issuance of an operations order is a case in point. SME interviews indicated that most operations orders (or frag orders) are issued by the team leader to the team in a group setting. During observation that particular pattern was indeed observed. However, so were other patterns for the same team activity. One common pattern was the issuance of the order in a group setting, followed by individual communicative dependencies with each team member (to clarify each team member's responsibility in the mission). It is highly unlikely the observed pattern would have emerged either from the documentation or SME interviews.

3. Observation identifies more dependencies than the other two methods, but these dependencies may or may not be important. For example, during observation, more communicative dependencies between team members were identified than by the other two sources. Typically, these "additional" communicative dependencies were associated with the following:

- a. A supplement to another dependency (e.g., a hand signal supplemented with oral communication). Typically, SME interviews or documentation would indicate the hand signal, but not the observed oral communication.
- b. Contingency events. During observation, it was obvious that "things" would not always go smoothly. As a result, "additional" dependencies would occur to correct the actions. Often these "additional" dependencies were not only communicative dependencies, but also procedural dependencies, which could not possibly be inferred from military documentation or SME interviews.
- c. Directions and orders. SMEs and documentation tend to assume the individual team members "know" their assignments. This is not the case during observation. Frequently team leaders issue communicative orders and directions to either correct individual actions or to point out ways an individual action can be performed easier. These kinds of dependencies are not evident from documentation and SME interviews.
- d. Status and verification. SMEs tend to "forget" that some dependencies are needed to verify that

individuals have completed their missions assignments. Observation clearly identifies these kinds of dependencies.

Although the observation method generated more data and dependency information, it is not positive that these "additional" dependencies are important for team training purposes or team performance evaluation purposes. Since there is some degree of uncertainty, it seems reasonable to suggest that the observation method is perhaps the best way to gather the information. It is better to have too much information rather than not enough information, given that we are in the early stages of the project.

In summary, the following statements can be made about the degree of consistency between team type descriptions and team behavior descriptions generated from the three sources:

1. Some degree of consistency between the three sources can be achieved if the documentation is clear and complete, if SMEs are aware of the documentation content, and if actual teams use (or at least follow) the documentation when performing missions. This is only likely to happen for very descriptive missions. Missions for which the documentation is ambiguous (or allows for local options) are likely to be described differently from all three sources.
2. Direct observation appears to generate descriptions which are more complete (contain more information). However, the utility of this additional information is not known. The additional information may either complicate or make easier the development and application of the training requirements identification procedure and the performance measurement identification procedure.

Problems Encountered

The three specified sources have their own unique set of problems. The problems experienced were not related to completing the required forms of the preliminary method. They were related to the ease of using the source. In the paragraphs below, the problems encountered in using each source is briefly summarized.

When using documentation as the primary source, the following problems were experienced:

1. There was considerable variability in clearness and completeness among the available documentation. As already noted for some missions the documentation was clear and complete, for other missions the documentation was almost non-existent.

2. In general, the documentation was not written with concern for team behaviors. As a result, the preparer is forced to make inferences and assumptions, particularly about the existence of dependencies, dependency patterns, and dependency types. Thus, the accuracy of descriptions generated from documentation alone should be considered suspect.
3. The documentation typically provided little information about team activity sequences. Typically, it discussed individual's activities causing the preparers to make inference to and about team behavior.
4. There were some problems in actually locating the most appropriate documentation. The preparers found themselves reading from various documents trying to select the most appropriate source to use. In fact, a good deal of time required to prepare the description was devoted to selecting the most appropriate documentation.
5. For each mission, many different documents can be used as sources. Frequently, the different documents contained contradictory information making it difficult for the preparers to make judgments and selections.

The SME interview process highlighted several potential problems. However, some of these problems were directly related to the way the interviews were conducted. It was initially planned that each interviewer would conduct the interviews on a one-to-one basis; i.e., one interviewer per SME. One interviewer, because of the circumstances, had to conduct a group interview (the size of the group varied over the two-day period from two to five SMEs). It was determined that the group interview technique was not a reasonable way to collect team behavior information. The following reasons are offered:

1. The SMEs in the group often had different views about how specific missions should be performed. As a result, much dialogue occurred between the SMEs, and the interviewer was forced to select points of view in order to generate the necessary descriptions.
2. Because of the variability among SMEs in the group, the resulting descriptions were not always internally consistent.
3. It was suspected that the group interview process requires more time to conduct per mission than the one-on-one interview.

In general, the following problems were encountered during both the one-on-one interviews and the group interviews:

1. There was considerable variability among the SMEs who participated. The quality of the resulting descriptions to a large extent depended upon the quality of the SMEs.
2. The interviewers found it difficult to explain exactly what they were after. SMEs have different views on what constitutes team behaviors. In fact, some SMEs found it difficult to think about team behaviors at all. They found it more comfortable to talk about individual activities than team activities.
3. The quality of the interviewer also influences the completeness of the resulting descriptions. Interviewers must use a probing technique, continually asking questions to clarify the information that has been volunteered by the SMEs. Thus, the interviewer must "know" the model to generate the right questions at the right time. Often the interviewers felt as though they had to "pull" the information from the SME, rather than have the information flow from the SME.

The interviewers felt that a structured interview schedule would be difficult to develop for the end user of the description method, because of the type of probing that was required.

4. SMEs, although willing to help, have other responsibilities and the time taken for the interview is often perceived as time which could have been devoted to completing those responsibilities. The extra duty attitude is indeed real and may influence the type of information obtained from SMEs.
5. Although the existence of dependencies was not difficult to identify from SME interviews, it was often difficult to "pull" enough information about the dependency from the SME to classify it by type, or to determine its purpose or pattern.

The observation method revealed a set of interesting problems. These problems were similar to those experienced with the primitive Description Method used during the development of the model. Basically, the problems were:

1. Observations can be difficult to arrange. The observed FORSCOM units must be willing to participate.
2. The observers typically had no control over the "quality" of the team observed. As such, one is never certain if the observed actual team is representative of other teams of the same type. Thus, one never "knows" if the resulting descriptions are representative.

3. Note taking during observation was a real problem. The observers found it convenient to use audiotape recorders because of their transportability.
4. It was difficult during the observation to set the bounds of the mission (its beginning and its end). Setting bounds from documentation and SME interviews appeared to be less difficult (at least less confusing). During observation, it was possible to observe several missions being merged together.
5. Observing large teams was extremely difficult, particularly if the team was not organized into static nested teams.
6. The ability to identify a dependency, depended to a large extent on the quality of the observer and his or her familiarity with the concepts in the model. The preparers, however, felt that it was easier to identify dependencies (and to determine dependency types) from observation than from the other two sources.
7. Some problems were experienced in getting to and from the location of the observation. Often the observers had to be transported to the mission site in different vehicles than the actual team. This meant that parts of missions could not be observed.
8. Frequently, the observer had to remain tactical (in order not to betray the actual team being observed). This condition inhibits the ability of the observers to clearly observe certain dependencies.

The discussion above indicates that there are problems associated with each of the three sources. However, the problems do not appear to be insurmountable for any given source.

The Final Description Method

Following the validation effort, the project was faced with the task of constructing a usable description method; i.e., to design the final versions of the recording forms and to suggest the ways that the data items on the forms could be gathered.

Minor changes were made in the recording forms. Two forms were deleted (the Deviation Report and the Actual Team Structure Organizational Chart), while one form was added (a form to record the actual nested teams and their functions). The Deviation Report was deleted because it was not a recording device, it was an analysis

device, and as such, belongs in the team training requirements method and/or the team performance measurement method. The Actual Team Organizational Chart was deleted because it was cumbersome to record the actual team structure when the actual team was comprised of many nested teams. A form was added to replace the Actual Team Structure Organizational Chart which requires the preparer to enter the name and function of each nested team, but not to show the relationship between the nested teams.

The mission activities recording form was altered to make it easier to use. Conceptually, the altered form was the same as the previous form, except it no longer required the user to describe in the space provided the activities of the individuals who participated in the dependency. The activities of the individuals are described in the comments column of the altered form.

A more difficult problem was to determine how the data to be entered in the recording forms were to be generated. This determination was made by examining the validation results. A matrix was made between the required data items and the three sources. In the cells of the matrix, comments were entered concerning how well the source could generate the required information. The comments were based upon the experiences gained during the validation effort. The matrix appears in Table 5.

In addition, another matrix was constructed. The rows of the matrix represented the three possible sources, while the columns of the matrix represented the various dependency types. In the cells of the matrix were comments concerning how easy or difficult it would be to identify the dependency types from the various sources. This matrix was constructed because the project staff felt that there were some differences among the sources with regard to how easy or different it would be to identify certain dependency types. The logic here was that the dependencies were often identified by first noting the dependency type. This matrix is presented in Table 6.

The two matrices were then logically analyzed and it was determined that:

1. Mission listing information could be reliably obtained from documentation.
2. Nominal team information (structure, organizational chart, position title, size, equipment, etc.) could be reliably and easily obtained from documentation.
3. Actual team information could only (by definition) be obtained from observation.
4. Specific mission team activities information could be obtained more reliably from observation than from any other

TABLE 5
MATRIX BETWEEN DATA ITEMS
AND SOURCE

DATA ITEM								
SOURCE	MISSION LISTING	NOMINAL TEAM POSITION TITLES	NUMBER OF NOMINAL TEAM MEMBERS	EQUIPMENT USED BY NOMINAL TEAM	ASSIGNMENT OF EQUIPMENT TO NOMINAL TEAM MEMBER	MISSION GOAL	MISSION PROCESSES	MISSION CONDITIONS
MILITARY DOCUMENTATION	Acceptable (If ARTEP Used) Impossible (If Not Used)	Acceptable (If TO & E Used) Unacceptable (If ARTEP Used)	Acceptable (If TO & E Used) Unacceptable (If Other DOC Used)	Acceptable (Some Variability)	Unacceptable (Information Not Provided in Documentation)	Acceptable (Try ARTEP)	Acceptable (Depending Upon Quality of Documentation)	Impossible (To Many Hypotheticals)
SME INTERVIEWS	Acceptable (If Requested to Review ARTEP Listing) Impossible (If Not Requested)	Acceptable (Some Variance in Titles)	Unacceptable (Considerable Variability)	Acceptable (Some Variability)	Unacceptable (Considerable Variability)	Unacceptable (Considerable Variability)	Unacceptable (Considerable Variability)	Impossible (To Many Hypothetical Conditions)
OBSERVATION	Impossible	Acceptable (If Supplement By Incumbent Interview)	Acceptable (If Supplement By Incumbent Interview)	Acceptable (If Supplement By Incumbent Interview)	Acceptable (If Supplement By Incumbent Interview)	Acceptable (Some Variability)	Acceptable (Some Variability)	Acceptable

TABLE 5 (Continued)

DATA ITEM								
SOURCE	SITUATIONAL MAP	ACTUAL TEAM POSITION TITLES	NUMBER OF ACTUAL TEAM MEMBERS	EQUIPMENT USED BY ACTUAL TEAM	ASSIGNMENT OF EQUIPMENT TO ACTUAL TEAM MEMBER	ACTUAL TEAM ORGANIZATION CHART	TEAM MEMBER FUNCTIONS	EXISTENCE OF NESTED TEAMS
MILITARY DOCUMENTATION	Acceptable (Must Infer Hypothetical)	Impossible (No Actual Team)	Impossible (May Provide Nominal, Only)	Impossible (May Provide Nominal, Only)	Impossible	Impossible	Acceptable (Depending Upon Quality of DOC)	Difficult
S&E INTERVIEWS	Acceptable (Considerable Variability for Hypothetical)	Limited (Unless Actual Team is Specified)	Limited (Unless Actual Team is Specified)	Limited (Unless Actual Team is Specified)	Limited	Limited	Marginally Acceptable (Considerable Variability)	Acceptable (Considerable Variability)
OBSERVATION	Acceptable (Real)	Acceptable (If Supplement By Incumbent Interview)	Highly Acceptable	Highly Acceptable	Highly Acceptable	Highly Acceptable	Acceptable	Highly Acceptable

TABLE 5 (Continued)

SOURCE	DATA ITEM								
	TEAM BEHAVIORS ACTIVITIES	SEQUENCE OF ACTIVITIES	DEPENDENCY INITIATOR	DEPENDENCY RECIPIENT(S)	DEPENDENCY ELEMENT	DEPENDENCY PATTERN	DEPENDENCY PURPOSE	DEPENDENCY TYPE	
MILITARY DOCUMENTATION	Limited Depends on Quality of DOC	Limited	Limited to Unacceptable	Limited to Unacceptable	Limited to Unacceptable	Unacceptable	Limited to Unacceptable (Requires Inference)	Limited if Types Require Inference	
SME INTERVIEWS	Limited Depends on Quality of SME	Limited (Considerable Variability)	Limited Considerable Variability	Limited (Considerable Variability)	Limited (Some Variability)	Limited (Considerable Variability)	Limited (Considerable Variability)	Limited Considerable Variability	
OBSERVATION	Acceptable (Some Inference Required)	Acceptable	Highly Acceptable	Highly Acceptable	Acceptable (Inference Required)	Highly Acceptable	Acceptable (Inference Required)	Acceptable Inference Required	

TABLE 6
CASE OF DETECTING DEPENDENCY TYPES

SOURCE	DEPENDENCY TYPE							
	COMMUNICATIVE (CD, CI)	STANDARD SIGNALS (N1)	TEAM SPECIFIC SIGNALS (N2)	MISSION SPECIFIC SIGNALS (N3)	PHYSICAL PRODUCT (PP)	PROCEDURAL (P1, P2)	TYPE I VIRTUAL (V1)	TYPE II VIRTUAL (V2)
DOCUMENTATION	Tendency to Call Other Types Communicative Because of Quality of Documentation	Ability to Detect Depends Upon Quality of Documentation	Unlikely to Detect	Unlikely to Detect	Likely to Detect	Ability to Detect Depends Upon Quality of Documentation	Unlikely to Detect; Even with High Quality Documentation	Unlikely to Detect; Even with High Quality Documentation
SME INTERVIEW	Some Specified by SME Were Not Observed	Easy to Identify	Unlikely to Detect - Often Misrepresented as N1	Unlikely to Detect - Often Misrepresented as N1	Likely to Detect	Likely to Detect the Obvious One	Unlikely to Detect	Unlikely to Detect
OBSERVATION	Easy to Identify	Easy to Identify	Easy to Identify	Easy to Identify	Likely to Detect	Likely to Detect Almost	Likely to Detect	Likely to Detect

source. In addition, the mission descriptions generated from observation appeared to be more complete, detailed, and comprehensive.

5. SME interviews were only useful to confirm information obtained from the other two sources.

Given these determinations, instructions were written for completing the forms (i.e., for generating the data to be entered in the forms).

To make the final version of the Description Method complete, a procedure for selecting the team type to be described and a procedure for sampling missions were developed. These two procedures were not tested (i.e., not validated), but were offered only to make the system as complete as possible.